REPORT

TO THE

NEW ENGLAND DIVISION CORPS OF ENGINEERS

ON

MONOOSNOC BROOK
FLOOD CONTROL
LEOMINSTER, MASSACHUSETTS
PRELIMINARY ENGINEERING ANALYSIS
OF
NON-STRUCTURAL FLOOD DAMAGE PREVENTION



Hayden, Harding & Buchanan, Inc.
Consulting Engineers

MARCH 1979



# Hayden, Harding & Buchanan Inc. Consulting Engineers

March 27, 1979

Department of the Army New England Division Corps of Engineers 424 Trapelo Road Waltham, MA. 02154

Attention: Colonel Max B. Scheider

Corps of Engineers

Deputy Division Engineer

Re:

Monoosnoc Brook Study

Non-Structural Flood Damage Prevention

Our Reference No. 78-312

#### Gentlemen:

Pursuant to your letter of 22 December 1978, we have completed and hereby submit our report for "Non-Structural Flood Damage Prevention" for the structures adjacent to the Monoosnoc Brook, Leominster, Massachusetts.

This report addresses the cost of floodproofing structures that would be affected by flood levels of the March 1936 Flood of Record and the design Standard Project Flood.

It must be noted that an in-depth, structure by structure field survey was beyond the scope of this project. The field survey consisted of a walking reconnaissance of the study area and collection of data that could be readily observed. A further in-depth survey could reveal conditions not otherwise apparent that could significantly affect the results of this preliminary study. It is felt, however, that the method used does give sufficiently accurate information upon which further decisions can be based.

March 27, 1979 Corps of Engineers Page 2

We appreciate the opportunity to have served the Corps in this flood prevention study and we are looking forward to a continued working relationship with you.

Very truly yours,

HAYDEN, HARDING & BUCHANAN, INC.

Ву

Warren H. Oster, P.E. Executive Vice President

Encl.

JAR:WHO/KLB

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for the S.P.F. Flood Levels

#### INTRODUCTION

The following report is a preliminary analysis of the estimated costs for non-structural flood damage prevention for structures affected by two flood levels of the Monoosnoc Brook in the Town of Leominster, Massachusetts.

This report evaluated residential, commercial, industrial and apartment buildings to determine what possible methods could be employed to floodproof these structures through various non-structural techniques.

Each structure was analysed to determine what non-structural flood technique could be appropriately used to protect each structure against two distinct flood levels, the March 1936 flood of record and the Standard Project flood (SPF). In a number of cases non-structural techniques of floodproofing were inappropriate and impractical. It was concluded that in these cases the use of non-structural techniques could not be applied without affecting the structural integrity of the building or severely limiting the practical use of the structure. Therefore, if a structure could not be floodproofed or raised above the flood level (an acceptable floodproofing technique), the structure was categorized as requiring demolition.

Sheets 2 and 3 of the Attachment shows the impact of the two flood levels investigated and what structures would require raising and demolition. All other structures evaluated within the study area could utilize non-structural flood techniques outlined in this report.

The information included in this study is not meant to be conclusive, but rather to provide a rough guide for the preliminary analysis phase from which future decisions may be made for a later, more detailed study. All work undertaken for this investigation was performed in accordance with Contract Number DACW33-77-0066, Work Order Number 12.

#### SUMMARY

In order to develop estimated costs of floodproofing individual structures located along the Monoosnoc Brook that would be subject to two distinct flood conditions, the following procedures were used: a field survey was performed to determine the type of structure and the estimated flood inundations. The structures were grouped into residential, commercial, industrial and apartment categories. Costs of floodproofing were estimated according to the size of the structure and the extent of inundation.

Floodproofing of residential structures consisted of providing a peripheral drainage system, waterproofing and blocking up basement walls and raising foundations. The extent of these measures was dependent upon basement usage and the depth of inundation. Costs were estimated using unit perimeter prices proportioned to the size of the house. Commercial using similar measures, however, the commerstructures were considered cial usage of the structure and the estimated extent of damage was taken into account. In some cases, such as when the primary use of the structure was that of a garage, it was assumed that water would enter the structure during a flood and exit during the recession without causing damage. In such cases no cost was applied. Other categories consisting of apartment buildings and industrial complexes were also studied. In some cases, due to the physical characteristics of the apartment building, commercial property or industrial complexes, nonstructural floodproofing techniques are not applicable. Such structures would require that flood walls or berms be constructed with flood gates to provide access. However, if flood walls, berms, or other conventional means of flood protection were

not practical, an estimated cost for demolishing the structure was developed as part of this report.

Structures were grouped into three separate river reaches which correspond to damage zones (indexes) stated in the main report of the structural improvements. (See Attachment Sheet 1) The three river reaches according to location are: Reach 1: Railroad Bridge to Water Street

Reach 2: Central Street to the Railroad Bridge

Reach 3: Pond Street to Central Street.

In all cases which were investigated, approximately 23 percent were conventional one family residential dwellings. The majority of these structures required Type A. B. C. or D floodproofing (see PROCEDURE Section) at an average cost per structure of eight to fifteen thousand dollars (\$8,000 - \$15,000) for the two flood conditions studied. About 37 percent of the structures studied were apartments and they required an average floodproofing cost per structure of eleven to seventeen thousand dollars (\$11,000 - \$17,000) for the two flood conditions. Commercial structures constituted about 35 percent of the cases studied, and their floodproofing cost averaged fourteen to eighteen thousand dollars (\$14,000 - \$18,000). Industrial building comprised approximately 5 percent of the cases studied for each of the two flood conditions. However, the cost to floodproof these structures represents approximately 25 percent of the total project costs. This is due primarily to the nonfeasibility of raising the foundations for multi-story and slab-on-grade structures. These structures required special floodproofing measures which, in most cases, proved to be either very expensive or impractical and therefore, for purposes of this study, were assumed to require demolition.

REPORT

#### I. PROCEDURE

## A. FIELD STUDY

The field study identified all structures which would be affected by the March 1936 flood of record and the Standard Project Flood (SPF). Structures were visually field evaluated for general condition, usage, size, first floor elevation, type of foundation and basement. Elevations were obtained from the Corps of Engineers photogrammetric topography plan. This plan had contours at five foot increments creating the need for estimating elevations. Photographs were taken and all observed changes from the topographic plan were recorded. It was observed during the field study that structures have been removed and new structures added since the date of the original plan. These changes have been reflected on the topography plan enclosed.

The above data was then compiled with respect to the elevation of the estimated flood surface (of the 1936 Flood and the SPF) for each structure. These elevations were obtained from historical records of the March 1936 Flood and from flood profiles developed for the U. S. Army Corps of Engineers, August 1978 report entitled "Leominister Local Protection, Feasibility Report for Water Resources Development". The depth of inundation was then estimated and the proper classification of floodproofing determined for each case and for each flood condition.

## B. FLOODPROOFING CLASSIFICATION

Generally, floodproofing for residential, apartment, industrial and commercial structures was divided into seven major categories. The categories were determined by the depth of inundation and the basement usage. The first three categories (Types A, B and C) were applied to structures where the proposed depth of inundation is below the first floor. Type D applies to cases where the flood waters are less than three feet above the first floor and all unusual cases were considered in a separate category (Type E) with each structure evaluated on an individual basis. Type F category applies to structures receiving no floodproofing. A final category (Type G) involves the case where the depth of inundation is greater than three feet above the first floor or there exists no practical means of floodproofing the structure. For this category demolition of the structures would be required. Structures that could not be raised or floodproofed by conventional methods were listed under this category.

The following represents a breakdown of each category indicating the measures to be taken and the assumptions used in classification:

#### TYPE A

Type A floodproofing is used for structures that have unfinished basements with no storage. Due to the difficulty in determining the basement usage without a more in-depth survey, the assumption was made that only houses in poor condition have no storage in their basements.

Type A floodproofing techniques consist of digging a trench in the basement floor and installing a drainage system to remove the

water that accumulates. The trench would be located around the periphery of the basement approximately two feet inward from the walls. The trench should have a depth of about two feet with a two foot wide bottom sloping upward on a one to two slope. A system of six inch diameter vitrified clay pipes leading to a sump hole containing a pump would be installed within the bottom of the trench and backfilled with crushed stone. The sump pump would require a separate electric outlet and will be connected to an outside hose which would divert water away from the basement. The top four inches of the trench will be finished concrete in order to restore the basement to its original condition. No cases fitting this method of floodproofing were encountered.

## TYPE B

Type B floodproofing is used for structures that have finished basements with storage but no living accommodations. It was assumed that all houses in fair to excellent condition having basements would be classified within this category. The procedures to be followed for this type of floodproofing consist of the Type A drainage system, as well as waterproofing of the outside of the basement walls. Waterproofing basement walls would require a trench be excavated around the outside periphery of the structure. The exposed basement walls would then be cleaned and waterproofing applied.

The trench would be backfilled and compacted and the yard restored to its original condition. For the flood of record and the Standard Project Flood, 122 structures and 68 structures respectively required this method of floodproofing.

# TYPE C

Type C floodproofing is applied to structures having finished basements being used for living quarters and storage. This technique requires the same measures as Type B with the additional precaution of blocking up all windows and doors. This would require the removal of existing doors and windows, to be replaced with block masonry. This measure could cause problems with regard to local fire and building codes. Such related problems were not formally addressed within the scope of this report. Only 1 structure for both flood conditions required this method of floodproofing.

#### TYPE D

which would receive a depth of inundation above the first floor. This technique would consist of the Type C technique with the additional measure of raising the foundation above the flood elevation. The raising of the foundation would require the structure be lifted by hydraulic jacks and temporarily supported by cribbing. All utility lines would be disconnected prior to this operation. The foundation would then be extended to the new elevation of the structure and the utilities reconnected. After the new foundation is completed, the jacks can be removed and the house and yard restored to their original condition. In order to perform this operation, it may be necessary to evacuate the occupants for approximately two to four weeks while

construction is being completed. Thirteen (13) structures under the flood of record and 52 under the SPF came under this category.

#### TYPE E

Type E floodproofing applies to residential and commercial cases which have a depth of inundation above the first floor, but cannot be floodproofed by any of the already mentioned procedures.

These structures were examined on an individual basis with explanations and costs presented in Appendix A. In all cases, a more detailed engineering investigation would be required prior to construction.

For commercial cases requiring flood shields, it should be noted that the shields are only installed during a flooding condition. Therefore, suitable warning time would have to be provided prior to a flood. Without this warning time, the structures would have limited protection which could result in substantial damage to the structures and their contents. For the flood of record and the SPF 9 and 18 structures respectively were grouped into this category.

#### TYPE F

Type F applies to structures which will receive no formal floodproofing under this study. Such structures are those which do not have full basements, are slabs-on-grade which are not affected by either flooding condition or those for which the residential or commercial usage of the structure does not dictate formal floodproofing. Thirty three structures and eight structures were grouped under this category for each of the two flooding conditions respectively.

#### TYPE G

Buildings that are placed into this category are structures that could not be floodproofed by either of the methods previously discussed.

Buildings placed into this category are structures which would receive a depth of inundation above or in excess of three feet above the first floor. Because of the structures construction (i.e. structure built on a slab or masonry structure, etc.) or intended use (i.e. drive-in bank) the application of the floodproofing methods discussed would affect the buildings' structural integrity or severely limit the practical use of the building. Structures categorized under Type G were classified, for the purpose of this study, as requiring demolition.

## C. COSTS

The costs for Type A, B, and C were obtained based on a unit cost per perimeter foot. The calculations used in formulating these costs are shown in Appendix B and the final rounded off values are presented in Table III. Costs for Type A, B and C floodproofing were obtained by multiplying the perimeter by the unit cost. Type D floodproofing is estimated assuming Type C costs plus an additional lump sum based on the estimated cost of raising the foundation. Type E floodproofing is estimated on an individual basis with the explanation presented in Appendix C according to the footnote number. Type F floodproofing requires no formal procedure and therefore no cost is assumed for this study. Structures listed under Category G and the associated demolition cost are presented in Appendix A and in Table I.

Since certain variables making up the floodproofing and foundation raising costs are related to the size of the building, different unit prices for different size buildings are presented in Table III. The raw unit costs used in these calculations are based on typical values from the Robert Snow Means Company, Inc., 1979 Building Construction Cost Data publication as

well as estimates provided by local contractors and our own engineering judgment. Final costs were derived from the raw costs with operational adjustments. These adjustments consist of an additional 10 percent for contingencies or unforeseen construction difficulties, an additional 10 percent for general contractors overhead and profit and 10 - 20 percent for engineering and survey fees. For this study, it was assumed that the engineering and survey fee would be 20 percent for Type A, B, and C flood-proofing, and 10 percent for foundation raising (Type D) where the experience of the contractor is most critical to the success of the operation.

# II. RESULTS OF NON-STRUCTURAL METHODS STUDIED

Table I lists each structure examined during this investigation.

Contained within this Table is the address, a code system describing the structure, the effect of the proposed flooding upon the structure and the recommended floodproofing technique and its cost. Also included in the Table is the estimated first floor elevation and perimeter of each structure. Commercial buildings or industrial buildings examined may also contain a footnote number. These numbers refer to Appendix A where the structure's description, usage and recommended floodproofing technique is presented on an individual basis. Within Table I, the column headed "Type" refers to a classification code system used in describing the structure. The first letter of the code system refers to the primary use of the structure, "C" refers to a commercial structure and "A" refers to an apartment building or complex containing more than four individual units. "R" refers to residential structures and "I" refers to an industrial building or complex. The adjacent second letter is used to define the primary material from

Tables IV and V represent the estimated cost for each Reach category respectively. Values used in these Tables were obtained from tabulation of quantities presented in Table I.

which the building is constructed. A "W" refers to wood framed and "B" refers to block or brick. The next number immediately following these two letters refers to the number of stories. A number containing "1/2" refers to a structure containing a finished or semi-finished attic apparently used for living or storage. The final number refers to the basement. A zero indicates no basement or slab-on-grade. A "1" refers to a crawl type basement, a "2" refers to an unfinished basement, a "3" refers to a finished basement, a "4" refers to an unfinished basement with an enclosed garage, a "5" refers to a finished basement with an enclosed garage and a "6" refers to an unfinished basement with storage. For all structures whose overall condition is rated poor, a "\*" follows the above code.

The column headed "Depth of Inundation" refers to the depth of water, above the basement floor, during each of the two proposed flood conditions examined. The column headed "Depth of Water above F.F." refers to the total height of water above the estimated first floor grade during the two floods. A blank in this column indicates that the water will not reach the first floor. In the case of a structure with a slab-on-grade foundation, the two columns will have the same value. The column headed "Cost in Thousands" refers to the estimated costs for floodproofing each structure or the costs of demolition if applicable.

Table II represents a breakdown of all cases considered, grouping the structures according to Reach Number. Each structure within the reach is further analyzed according to the type of structure, the size and the recommended floodproofing technique.

Table III represents the estimated cost of different floodproofing techniques. Table values were obtained according to procedures described in Section I.C. of this Report.

TABLE I

REACH NO. 1

					•								REAC	H NO. 1
	STREET	HOUSE	TYPE	ESTIMATED F.E ELEVATION	ESTIMATED PERIMETER LF		H OF ATION	WA	TH OF TER /E F.F.	FLOOD	POSED PROOF NIQUE	\$ 1000	T IN 0.00'S	FOOTNOTE:
				LLLVATION	£.;	1936	SPF	1936	S.P.F.	1936	S.P.F.	1936	SPF	
	Mechanic Street	52	CB-1-2	397	570	7	9	0	0	E	Е	.3.3	3.3	1
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	Spruce Street	38	IB-3-0	365	1000	2	4	2	4	E	Е	42.0	42.0	2
	Spruce Street	40	IB-2 <sup>1</sup> <sub>2</sub> -0	352	see footnote	6	8	6	8	E	Е	106.0	106.0	3
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-15-	Water Street	71-75	IB-2- 0	379	800	2	4	2	4	Е	E	23.0	23.0	4
	Water Street	81	RW-2 <sup>1</sup> <sub>2</sub> -3	380 363 office	260	0	0	0	0	F	F	0.0	0.0	
	Water Street	100	IB-4- 0		see footnote	1	3	1	3	Е	E	37.0	37.0	5
	Water Street	102	IBW-4-0	356	690	0	1	0	1.	E	E	10.0	10.0	6
	Water Street	124	IBW-3 <sup>1</sup> <sub>2</sub> -2	varies	see footnote	11	3	1	3	E	E	93.0	93.0	7
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# DESCRIPTION OF SYMBOLS USED IN TABLE I

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	STREET	NO	,	ELEVATION	LF	1936	S.P.F.	1936	S.P.F.	1936	S.P.F.	1936	S.P.F	
	Adams Street	35	CW-2-2*	395	160	16	20	5	9	G	G	1.5	1.5	•
-14-	Mechanic Street	52	CB-1-2	397	570	7	10	0	0	E	E	3.3	3.3	1
	Cotton Street	36	RW-2-2	407	160	3	7	0	0	В	В	9.1	9.1	
1	Category  A- APARTMENT C- COMMERCIAL R- RESIDENTIAL I- INDUSTRIAL  Predominant Structural Mate	rial		2- FINISHED 3- FINISHED 4- UNFINISH 5- FINISHED	ENT ED BASEMENT, BASEMENT WI BASEMENT LI BASEMENT WI BASEMENT WI BASEMENT WI BASEMENT WI	TH STO VING A WITH E TH ENC	rage REA NCLOSEI LOSED (	) GARAG GARAGE	T T T T	YPE B- YPE C- YPE D- YPE E-	PERIPH TYPE A OF BAS TYPE F WINDOW TYPE C UNUSUA NO FOR	ERIAL : A PLUS ' SEMENT ' B PLUS ' S PLUS ' C PLUS ' AL COND   RMAL FL	DRAINAC WATERPH WALLS BLOCKIN RAISING ITIONS OODPROG IG NOT	GE SYSTEM ONLY ROOF OUTSIDE  NG UP OF  G FOUNDATION  - SEE FOOTNOT  OFING TECHNIQUE  PRACTICAL

DEMOLITION OF STRUCTURE

Number Of Floors

B- BRICK OR BLOCK

W- WOOD

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STREET	HOUSE	TYPE	ESTIMATED F.F.	ESTIMATED PERIMETER	1	H OF ATION	WA	TH OF TER VE FF	FLOOD	POSED PROOF NIQUE	COST IN \$ 1000.00'S	FOOTNOTE
			ELEVATION	LF	1936	S.P.F.	1936	S.P.F.	1936	S.P.F.	1936 SPE	
Central Street	12	CB-1-0	397	120	0	1	0	1	F	Е	0.0 1.3	8
Central Street	14	CB-1-0	397	120	0	1	0	1	F	E	0.0 1.3	8
Central Street	16	CB-1-0	397	300	0	1	0	1	F	Е	0.0 1.4	8
Central Street	16R	CB-1-0	398	120	0	0	0	0	F	F	0.0 0.0	
Central Street	18	CB-1-2	397	250	11	14	0	. 3	F	G	0.0 3.6	9
Central Street	20	CB-1-2	397	120	11	14	0	3	F	G	0.0 0.5	9
Central Street	22	CW-2-0	397	300	0	3	0	3	F	G	0.0 10.8	9
Central Street	88	RW-2 <sup>1</sup> <sub>2</sub> -2	398	130	7	10	0	2	В	D	7.4 22.2	
Central Street	94	AW-2 <sup>1</sup> 2-2	397	180	8	11	0	3,	В	D	10.1 26.9	
Central Street	100	AW-3-2	398	160	7	10	0	2	В	D	9.1 24.1	
Central Street	104	AW-1½-2	395	180	10	13	2	5	D.	G	26.9 3.1	
Central Street	106	AW-2 <sup>1</sup> 2-2	397	160	9	12	1	4	D	G .	24.1 2.9	
Central Street	112	CW-1½-2	401	200	5	8	0	0	В	В	11.3 11.3	
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				ELEVATION	LF	1936	S.P.F.	1936	S.P.F.	1936	S.P.F.	1936	SPF	
	Depot Square	8	AB-2 <sup>1</sup> 2-2	398	180	5	8	0	0	В	В	10.1	10.1	,
	Depot Square	16	CWA-3-2	398	220	5	8	0	0	В	В	12.4	12.4	
	Depot Square	26	CW-112-2	397	80	6	9	0	0	В	В	4.7	4.7	
	Lancaster Street	17	AW-2 <sup>1</sup> 2-3	406	200	0	3	0	. 0	F	В	.0.0	11.3	
-17-	Lancaster Street	19	RW-2 <sup>1</sup> <sub>2</sub> -3	408	160	0	1	0	0	F	В	0.0	9.1	-
Ī	Lancaster Street	23	RW-2 <sup>1</sup> 2-2	404	230	1	4	0	0	В	В	13.0	13.0	
	Lancaster Street	27	AW-2 <sup>1</sup> <sub>2</sub> -2	406	200	00	3	0	0	F_	В	0.0	11.3	
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	Main Street	l	CB-3 <sup>1</sup> 2-3	402	380	4	7	0	0	В	В	21.4	21.4	>
	Main Street	29	CB-2-3	400	340	2	5	0	0	В	В.	19.2	19.2	
	39-41-4 Main Street 47		CB-3-3	400	660	1	4	0	0	В	В	37.2	37.2	
	Main Street	53	CB-4-3	400	420	1	4	0	0	В	В	23.7	23.7	,
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	Manning Avenue	Car Tops	CB-1-0	396	180	0		0	0	F	F	0.0	0.0	Market Strange Handle Line
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	STREET	HOUSE NO	TYPE	ESTIMATED F.F. ELEVATION	ESTIMATED PERIMETER LF	1	TH OF DATION	WA	TH OF ATER VE FF	FLOOD	POSED D PROOF INIQUE	i	ST IN 0.00'S	FOOTNOTE #
1		· · · · · · · · · · · · · · · · · · ·		ELEVATION	LF	1936	SPF	1936	S.P.F.	1936	S.P.F.	1936	SPE	
	Mechanic Street	17-19	CB-1-2	395	280	8	11	0	1	В	D	15.8	35.1	,
***************************************	Mechanic Street	39	CB-4-2	395	460	1	4	0	0	В	В	25.9	25.9	
	Mechanic Street	40/46	CB-1-0	393	260	0	1	0	1	F	E	0.0	18.9	· 10
	Merriam Avenue	6	CW-1 <sup>1</sup> 2-3	397	80	6	9	0	0	В	В	4.7	4.7	
		1												
-18-	Monument Square	2-4-6- 8-10	•	400	320	2	5	0	0	В	В	18.0	18.0	-
	Monument Square	12-14 16-18	CB-4-2	400	580	2	5	0	0	В	В	32.7	32.7	
	Monument Square	SAMBOS	CB-1-0	399	340	0	O	0	0	F	F	0.0	0.0	
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	Water Street	14	CB-2-2	396	260	6	9	0	0	В	В	14.7	14.7	
	Water Street	17	CB-1-2	396	380	6	9	0	0	E	Ε.	. 33,4	33.4	iı
	Water Street	19	CB-3 <sup>1</sup> 2-2	396	200	6	9	0	0	В	В	11.3	11.3	11
	Water Street	21	CW-1-0	397	240	0	0	0	0	F	F ·	0.0	0.0	11
	Water Street	23	CB-1-0	397	120	0	0	C	0	F	F	0.0	0.0	11
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	STREET	HOUSE NO	TYPE	ESTIMATED E.F.	ESTIMATED PERIMETER	1	TH OF DATION	WA	TH OF ATER OVE FF	FLOOD	POSED D PROOF INIQUE	COST IN \$ 1000.00'S	FOOTNOTE #
	(		1	ELEVATION	LF	1936	SPE	1936	S.P.F.	1936	S.P.F.	1936 SPF	
******	Adams Street	Bank 20	CB-2-3	396	250	15	19	4	8	G	G	20.0 20.0.	
	Adams Street	35	CW-2-2*	395	160	16	20	5	9	G	G	1.5 1.5	
	Adams Street	39	AW-3-2	402	120	6	10	0	2	В	D	7.1 20.6	
	Adams Street	43	AW-3-2	402	160	6	10	0	2	В	D	9.1 24.1	
	Adams Street	47	AW-3-2	402	180	6	10	0	` 2	В	D	10.1 26.9	
-10-	Adams Street	71	AW-3-2	402	160	6	10	0	2	В	D	9.1 24.1	
	Adams Street	73	AW-3-2	402	180	6	10	0	2	В	D	10.1 26.9	
	Adams Street	80	RW-1½-2	403	140	6	10	0	2	В	D	7.9 22.8	
	Adams Street	81	RW-1½-2	403	140	6	10	0	2、	В	D	7.9 22.8	
	Adams Street	83-85	AW-2-2	404	180	5	9	0	1	В	D	10.1 26.9	
	Adams Street	84	RW-1 <sup>3</sup> 2-2	402	140	7	11	0	3	В	D ·	7.9 22.8	
	Adams Street	87-89	AW-2 <sup>1</sup> 2-2	404	160	5	9	0	1	В	D ,	9.1 24.1	
	Adams Street	88	RW-1½-2	402	140	7	11	0	3	В	D .	7.9 22.8	ł
	Adams Street	91-93	AW-2 <sup>1</sup> 2-2	406	180	3	7	0	0	G	G	4.2 4.2	12
	Adams Street	92	RW-1½-2	403	160	6	10	0	2	В	D	9.1 24.1	
	Adams Street	121	CW-1-0	403	100	0	3	0	3	F	G	0.0 0.5	13
		•		t					The state of the s	A STATE OF THE PARTY OF THE PAR	CONTRACTOR OF CO	My desirable for the first state and printer the special contraction of the state o	**************************************

		STREET	HOUSE NO	TYPE	ESTIMATED F.F.	ESTIMATED PERIMETER	1	H OF	WA	H OF TER /E FF	FLOOD	POSED PROOF NIQUE	1	ST IN 0.00'S	FOOTNOTE
		and the state of t			ELEVATION	LF	1936	SPE	1936	S.P.F.	1936	S.P.F.	1936	SPF	
	Adams	Street	125	AW-2 <sup>1</sup> 2-2	406	180	4	8	0	0	В	В	10.1	10.1	
	Adams	Street	129	RW-2 <sup>1</sup> 2-2	407	180	3	7	0	0	В	В	10.1	10.1	
	Adams	Street	98 95	IB-2-0	401	2330	1	4	1	4	G	G	304.0	304.0	23
	Bowen	Place	140	IW-4-2	407	480	8	12	0	· 1	В	G	27.0	36.0	14
3	Bowen	Place	143	AW-3-2	410	220	2	6	0	0	В	В	12.4	12.4	-
	Bowen	Place	149	RW-2-2	410	100	3	7	0	0	В	В	5.9	5.9	
	Bowen	Place	153	RW-2-2	410	120	3	7	o	0	В	В	7.1	7.1	
	Bowen	Place	158	RW-2-2	408	160	5	9	С	l.	В	D	9.1	24.1	
	Bowen	Place	161	RW-2-2	408	80	6	10	С	2	В	D	4.7	17.7	*
	Bowen	Place	162	RW∞2∞2	408	120	6	10	0	2.	В	D .	7.1	20.6	
	na Magyanau, i yapan sa Masari a	१४ प्रमान्त्रः । स्थानः स्थान्त्रः क्रान्त्रः । अस्ति स्थानः स्थानः स्थानः स्थानः स्थानः स्थानः स्थानः स्थानः		anders retributed to secure retributed but	- Anna Barrier - Anna Barrier - Anna Anna Barrier - Anna Barrier - Anna Barrier - Anna Barrier - Anna Barrier	er Belgere gypon-renovement-ver von Con gyprodess 1994, hinni op over						•			
	Bovle	Place	12-14 16-18	AW-2-2	397	240	11	15	3	7	D	G .	32.6	6.0	
		Place	21-23 25	AW-3-2	398	200	10	14	2	6	D	G	30.2	6.3	
	Boyle	Place	28	RW-2-2	395	200	13	17	5	9	G	G	1.7	1.7	
	-	Place	28R	CW-1-0	391	260	9	13	9	13	G	G	3.0	3.0	

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	STREET	HOUSE NO	TYPE	ESTIMATED F.F. ELEVATION	ESTIMATED PERIMETER LF	i	H OF		H OF FER E FF	FLOOD	POSED PROOF NIQUE	\$ 1000	T IN 0.00's	FOOTNOTE #
				CCC VAI 101V	<u></u>	1936	SPF	1936	S.P.F.	1936	S.P.F.	1936	SPE	
	Boyle Place	33 <b>-</b> 35 37	AW-3-6	396	200	12	16	4	8	G	G	6.3	6.3	
	·													
	Central Stre	1-7- 9	CB-3-2	397	300	11	15	0	4	G	G	16.9	49.0	
	Central Stre	et 11/17	CW-1/1½-2	397	460	12	16	1	5	G	G	12.8	12.8	15
	Central Stre	21-23 25	CW-1-2	397	100	13	17	2	6	G	G	. 2.3	2.3	15
-21-	Central Stre	et 27	CW-1-0	398	470	2	6	2	6	G	G	10.4	10.4	15
	Central Stre	et 33/37	CB-3-2	399	200	11	15	0	4	В	G	11.3	14.2	
	Central Stre		CB-3-2	396	200	14	18	3	7	D	G	30.2	8.0	
	Central Stre	DINER eet 61	CW-1-2	396	50	14	18	3	7.	D	G	15.6	0.5	
	Central Stre	69	CW-3-2	396	160	14	18	3	7	D	G	24.1	4.5	
	Central Stre	75-91 eet 95	CW-3-2	396	250	13	17	2	6	G.	G.	13.0	13.0	15
	Central Stre	eet 95	RW-2 <sup>1</sup> 2-2	396	200	10	14	2	6	D	G	30.2	5.0	
-	Central Stre	et 103	CAW-2 <sup>1</sup> 2-2	,398	200	10	14	0	3	В	D	11.3	30.2	
	Central Stre	et 105	AW-2 <sup>1</sup> 2-2	399	210	6	10	0	2	В	D	11.8	30.8	
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PROPOSED DEPTH OF DEPTH OF COST IN **ESTIMATED ESTIMATED** WATER FLOOD PROOF HOUSE FOOTNOTE \$ 1000.00's INUNDATION STREET TYPE F.F. PERIMETER ABOVE F.F. TECHNIQUE # NO **ELEVATION** LF 1936 1936 SPE 1936 S.P.F. 1936 S.P.F. SPF 140 8 4 0 4 D G 22.8 2.9 Cottage Street CAW-3-2 400 AW-23-2 403 360 5 9 0 1 В 20.3 40.0 Cottage Street 14 Q Cottage Street 16 RW-1-2 402 100 6 10. 0 2 В D 5.9 19.1 2 Cottage Street 19 AW-2-2 403 240 6 10 0 В D 13.5 32.6 0 10.1 10.1 4 0 Cottage Street 20 AW-2-2 404 180 8 B В 0.0 11.3 0 F Cottage Street 21-23 AW-3-2 409 200 0 4 0 В F 0.0 Cottage Street 22 RW-112-0 405 80 0 0 0 0 F 0.0 Cottage Street 65 AW-23-2 410 120 0 4 ٥ 0 F E 0.0 .33.1 16 20.3 17 Cottage Street CBW-1-2 408 360 8 12 0 1. В G 6.0 83 10.1 10.1 Cottage Street 85 AW-23-2 410 180 3 0 0 B B В 10.1 10.1 180 0 0 ٥ В Cottage Street 93 AW-23-2 414 0.0 18.0 29-31 AW-23-2 413 320 0 0 0 F B , Cotton Street 3 RW-212-3 407 160 3 7 0 0 В В 9.1 9.1 34 Cotton Street 9.1 9.1 Cotton Street 36 RW-2-2 407 160 3 7 0 0 B В Cotton Street 37 AW-21-2 411 160 1 5 0 9.1 9.1 0 B B

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	STREET	HOUSE NO	TYPE	ESTIMATED F.F. ELEVATION	ESTIMATED PERIMETER LF	INUND	TH OF DATION	ABO	TH OF ATER OVE F.F.	FLOOD TECH	POSED D PROOF INIQUE	\$ 1000	ST IN 0.00'S	FOOTNOTE
**************************************	Cotton Street	43	CAW-3-2	409	200	1936	S.P.F.	1936	S.P.F.	1936 B	S.P.F.	1936	11.3	
	COLLOII STIEET	***	CAW-J-Z	403	200	-					1.7		11 a J	
- The section of the	Franklin Street	1	RW-2-2	403	220	5	9.	0	1	В	D	12.4	31.4	
	Franklin Street	8	RW-2-2	400	180	8	12	0	4	В	G	10.1	2.8	
	Franklin Street	9	RW-1½-2	400	120	8	12	0	4	В	G	. 7.1	1.2	
-23-	Franklin Street	15	RW-1 <sup>1</sup> 2-2	404	140	4	8	0	0	В	В	7.9	7.9	
	Franklin Street	16	AW-2 <sup>1</sup> 2-2	401	180	7	11	0	3	В	D	10.1	26.9	
	Franklin Street	21	RW-112-2	402	140	6	10	0	2	В	D	7.9	22.8	
	Franklin Street	22	RW-1 <sup>1</sup> 2-2	402	140	6	10	0	2	В	D	7.9	22.8	
	Franklin Street	28	AW-2-2	403	170	5	9	0	1	В	D	9.6	26.3	
	Franklin Street	29	AW-2-2	406	140	2	6	0	0	В	В	7.9	7.9	
-	Franklin Street	30	AW-112-2	404	240	4	8	0	O	В	В	13.5	13.5	
	Franklin Street	31	AW-2 <sup>1</sup> 2-2	406	140	2	6	0	0	В	В	7.9	7.9	
1	Franklin Street	34	RW-1-2	403	160	5	9	o	1	В	D	9.1	24.1	
,	Franklin Street	37	CB-1-0	400	200	0	4	o	4	F	G	0.0	2.1	
	Franklin Street	38	AW-2½-2	407	200	1	5	o	0	В	В	11.3	11.3	

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	STREET	HOUSE NO	TYPE	ESTIMATED F.F.	ESTIMATED PERIMETER	DEPT INUND	H OF ATION	WA	TH OF TER /E F.F.	FLOOD	POSED PROOF NIQUE	\$ 1000	ST IN 0.00'S	FOOTNOTE
-	i			ELEVATION	LF	1936	SPF	1936	S.P.F.	1936	S.P.F.	1936	SPE	
	Franklin Street	51	RW-2½-2	403	120	5	9	0	1	В	D	7.1	20.6	
	Franklin Street	54	AW-2½-2	406	180	2	6	0	0	В	В	10.1	10.1	
	Main Street	2-4 6-8	CB-3 <sup>1</sup> 2-2	402	380	4	8	0	0	В	В	21.4	21.4	
	Main Street	18-20	CB-5½-2	402	400	2	6	0	. 0	В	В	22.5	22.5	
-24-	Main Street	22 <b>-</b> 24 26	CB-3½-2	400	900	1	5	0	0	В	В	50.7	50.7	-
	<u> </u>													•
	Monument Square	21	CB-1-2	399	260	8	12	0	1	В	E	14.7	15,8	18
	23 Monument Square	3-25-27 31-33	CB-2-2	399	260	8	12	0_	1.	В	E	14.7	17,5	18
	Monument Square	35	CB-1-0	399	240	0	0	0	1	В	E	13,5	14.6	18
										,	•			
	Park Street	1-3	CB-3-2	400	530	7	11	0	0	В	В	29.9	29.9	
	Park Street	5	CB-1-2	401	530	6	10	0	0	В	В '	29.9	29.9	
	Park Street	7-9 11	CB-1-2	402	530	5	9	0	0	В	В	29.9	29.9	
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					madetacos anno ministry proposo su en 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		i .		nderführt und popularie der Antonie verweichten.		and were the district of the property of the first of the		·····································	
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STREET	HOUSE NO	TYPE	ESTIMATED F.F.	ESTIMATED PERIMETER	\$	TH OF DATION	WA:	TH OF ATER OVE FF	FLOOD	POSED D PROOF HNIQUE	• •	OST IN OO.OO'S	FOOTNOTE
			ELEVATION	LF	1936	SPF	1936	S.P.F.	1936	S.P.F.	1936	SP.F.	
Pearl Street	8	RW-2-2	403	160	4	8	0	0	В	В	9.1	9.1	
Pearl Street	16	AW-2 <sup>1</sup> 2-2	408	300	0	4	0	0	F	В	0.0	16.9	
Pearl Street	22	AW-2 <sup>1</sup> <sub>2</sub> -2	410	280	0	2.	0	0	F	В	0.0	15.8	
Pearl Street	56	AW-2 <sup>1</sup> <sub>2</sub> -2	414	220	0	1	0	0	F	В	0.0	12.4	
Pearl Street	80	AW-2 <sup>1</sup> 2-2	414	180	0	1	0	. 0	F	В	. 0.0	10.1	
	!							aga garan di Maliferia di Malif	ļ.	D 1996 dawn franchische Gerichtstein der Freise der Fre			
Pleasant Place	9-11	AW-3-2	402	180	6	10	.0	2	В	D	10.1	. 26.9	
Pleasant Place	10-12	AW-3-2	403	180	5	9	0	1	В	D	10.1	26.9	
Pleasant Place	18-20	AW-3-2	402	180	6	10	0	2.	В	D	10.1	. 26.9	
Pleasant Place	19-21	AW-3-2	402	180	6	10	o	2	В	D	10.1	26.9	
Pleasant Place	29	AW-3-2	402	260	7	11	o	3	B.	D.	14.7	33.9	
										•		The state of the s	and the second of the second
Pleasant Street	7-9 11-15	5 CB-1-2	400	280	7	11	0	0	В	В	15.8	15.8	* 11 - 12 - 12 - 12
Pleasant Street	5	CB-3-2	400	200	7	11	O	0	В	В	11.3	11.3	
Pleasant Street	23	CB-1-0	400	140	0	1	0	1	F	E	0.0	1.1	19
Pleasant Street	27	AW-3-2	401	140	5	9	o	1	В	D	7.9	22.8	

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	STRE	ET	HOUSE NO	TYPE	ESTIMATED F.F. ELEVATION	ESTIMATED PERIMETER LF	DEPT	H OF ATION	WA	TH OF TER VE F.F.		OSED PROOF NIQUE		ST IN 0.00'S	FOOTNOTE
					ELEVATION	LF	1936	SPE	1936	S.P.F.	1936	S.P.F.	1936	SPE	
	Pleasant	Street	29	AW-3-2	401	140	6	10	0	2	В	D	7.9	22.8	
	Pleasant	Street	30	CB-1-0	395	280	4	8	4	8	G	G	7.3	7.3	
	Pleasant	Street	31	AW-3-2	404	140	4	8.	-0	0	· B	В	7.9	7.9	
	Pleasant	Street	35	AW-3-2	401	180	6	10	0	2	В	D	10.1	26.9	
	Pleasant	Street	36	ACB-3-2	397	160	13	17	2	6	D	G	24.1	3.6	
-26-	Pleasant	Street	36R	RW-1 <sup>1</sup> 2-2	398	160	8	12	0	4	В	G	9.1	1.2	
	Pleasant	Street	38	AW-3-2	398	160	9	13	1	5	D	G	24.1	3.6	
	Pleasant	Street	38R	RW-13-0	398	160	1	5	1	5	D	G	24.1	1.2	
	Pleasant	Street	39	AW-2-2	400	200	8	12	0	4.	В	G	11.3	3.0	
	Pleasant	· · · · · · · · · · · · · · · · · · ·	y Shop 39R	CB-1-0	397	280	3	7	3	7	G	G	4.2	4.2	,
	Pleasant	Street	40	ARW-2-2	400	180	8	12	0	4	B'	G.	10.1	2.3	
	Pleasant	Street	40R	CW-1-0	395	370	4	8	4	8	G	G .	0.5	0.5	
-	Pleasant	Street	41	AW-3-2	400	160	8	12	0	4	B	G .	9.1	3.6	,
	Pleasant	Street	43	AW-3-2	400	140	8	12	0.	4	В	G	7.9	3.6	
	Pleasant	Street	44-46	AW-3-2	401	180	7	11	0	3	В	D	10.1	26.9	
	Pleasant	Street	47	CB-1-0	400	620	0	0	0	4	F	G	0.0	10.4	
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	STRE	STREET HOUSE		TYPE	ESTIMATED F.E ELEVATION	ESTIMATED PERIMETER LF	DEPTH OF INUNDATION		DEPTH OF WATER ABOVE FF		FLOOD	POSED PROOF NIQUE	\$ 1000	NI TE 2.00'S	FOOTNOTE #	
Ì	•				ELEVATION	Lr	1936	SPF	1936	S.P.F.	1936	S.P.F.	1936	SPF		
المسترد مستناه	Pleasant	Street	48	CW-1½-2	401	220	10	14	0	3	В	D	12.4	31.4		
	Pleasant	Street	53-55	AW-3-2	401	240	7	11	0	3	В	D	13.5	32.6		
	Pleasant	Street	54-56	ACW-2 <sup>1</sup> 2-2	404	200	7	11	0	0	В	В	11.3	11.3		
	Pleasant	Street	64	AW-3-2	403	220	5	9	0	1	В	D	12.4	31.4		
	Pleasant	Street	65	ACW2 <sup>1</sup> 2-2	402	180	9	13	0	· 2	В	D	.10.1	26.9		
-27-	Pleasant	Street	68	RW-1½-2	402	160	6	10	0	2	B	D	9.1	24.1		
	Pleasant	Street.	68R	CW-112-2	403	180	8	12	0	1	В	D	10.1	26.9		
	Pleasant	Street	71	CB-2-3	405	260	6	10	0	0	G	G	6.4	6.4	20	
	Pleasant	Street	71R	CB-1-0	399	180	2	6	2	6.	G	G	2.0	2.0		
	Pleasant	Street	74	RW-1 <sup>1</sup> 2-2	402	160	6	10	0	2	В	D	9.1	24.1		
	Pleasant	Street	75	RW-1½-2	402	110	6	10	0	2	В	D ·	6.5	19.8		
	Pleasant	Street	75R	RW-2 <sup>1</sup> 2-2	402	140	6	10	<u>c</u>	2	В	D	7.9	22.8		
	Pleasant	Street	79/81	ACW-3-2	403	160	5	9	0	1	В	D.	9.1	24.1	,	
	Pleasant	Street	80	CB-1-0	400	160	0	4	0	4	F	G	0.0	1.2		
	Pleasant	Street	82	RW-2 <sup>1</sup> 2-2	. 402	140	6	10	0	2	В	D	7,9	22.8		
	Ti oacant	Street	83	CB-2-3	399	440	12	16	1	5	Ğ.	G	13.0	13.0	21	

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STREET	STREET		TYPE	ESTIMATED F.F.	ESTIMATED PERIMETER LF	1	H OF ATION	WA	TH OF TER VE FF	PROPOSED FLOOD PROOF TECHNIQUE			ST IN 0.00'S	FOOTNOTE
				ELEVATION	Lr	1936	S.P.F.	1936	S.P.F.	1936	S.P.F.	1936	SPF	
Pleasant Str	reet	84	CW-1½-1	400	200	11	15	0	4	В	G	11.3	1.8.	
Pleasant Str	reet	86	AW-2 <sup>1</sup> 2-2	404	160	4	8	0	0	В	В	9.1	9.1	
Pleasant St	reet	92	CW-1-2	408	220	3	7	0	0	G	G	2.0	2.0	
Pleasant St	reet	92R	CB-2-0	395	160	5	9	5	9	G	G	4.6	4.6	
Pleasant St	reet	102 <b>-</b> 104	AW-2 <sup>1</sup> 2-2	402	180	2	6	0	0	В	В	10.1	10.1	
Pleasant St	reet	110	RW-1 <sup>1</sup> 2-2	406	140	2	6	0	0	В	В.	7.9	7.9	-
Pleasant St	reet	112	RW-1½-2	406	160	2	6	0	0	В	В.	9.1	9.1	,
Pleasant St	reet	114	RW-112-2	406	100	2	6	0	0	В	В	5.9	5.9	
Pleasant St	reet	120	AW-2½-2	407	200	1	. 5	0	0.	В	В	11.3	11.3	
Pleasant St	reet	126	AW-2½-2	405	180	3	7	0	0	В	В	10.1	10.1	
Pleasant St	reet	130	AW-2 <sup>1</sup> 2-2	407	160	1	5	0	0	В	B.	9.1	9.1	
Pleasant St	reet	138	RW-2 <sup>1</sup> 2-3	405	120	3	7	0	0	С	C ,	7.6	7.6	
Pleasant St	reet	158	CW-3-2	400 lower 406 f.f.	400	11	14	0	3	E	E,	75.0	75.0	22
												,		
Pond Street		14	RW-21/2-2	420	160	0	0	0	0	F	F	0.0	0.0	
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TABLE I

REACH NO. 3

													REACH	I NO. 3
STRE	STREET TYPE F.F.			ESTIMATED F.F. ELEVATION	ESTIMATED PERIMETER LF			WA:	TH OF TER /E FF	FLOOD	POSED PROOF NIQUE	t	ST IN 0.00'S	FOOTNOTE
					L-1	1936	SPF	1936	S.P.F.	1936	S.P.F.	1936	SPF	
Pond Stree	et	20	IBW- 3-2	420 upper: 403 storage	640	3	7	0	0	G	G	78.0	78.0	
Pond Stree	et	44	IBW1-0	420 upper 403 garage	510	3	7	0	0	G	G.	9.0	9.0	
														·
Union Str	eet	11	CW-2 <sup>1</sup> 2-2	397	160	12	16	1	5	D	G	24.1	3.0	
Union Str	eet	12	RW-2 <sup>1</sup> <sub>2</sub> -2	398	160	8	11	0	. 3	В	D	. 9.1	24.1	
Union Str	eet	14	AW-2 <sup>1</sup> <sub>2</sub> -2	402	200	4	8	0	0	В	В	11.3	11.3	
Union Str	eet	15	AW-2½-2	403	220	4	8	0	0	В	В	12.4	12.4	
Union Str	eet	41	AW-21:-2	411	160	0	1	0	0	F	В	0.0	9.1	
Union Str	eet	51-53- 55	AW-2-2	405	260	3	7	0	0.	В	В	14.7	14.7	
Union Str	eet	59	RW-2-2	406	220	2	5	C	0	В	В	12.4	12.4	
Union Str	eet	65	AW-2 <sup>1</sup> <sub>2</sub> -2	409	220	-0	3	0	0	F	В,	0.0	12.4	
Union Str	eet	67	RW-2-2	408	120	0	4	o	0	F	В	0.0	7.1	
	-										•			
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	**************************************												de la constante de la constant	
	ANNEAR PROPERTY OF THE PROPERT				The state of the s		orani rationale and the second of				eraphicipalitation and property desired	-	Hardington & Action 10 Condition	

-29-

TABLE II

							SIZE	IN PER	IMETER F	EET				FL	OOD	PRC	OFI	NG	TEC	HNI	QUE	3	
****Contractor		NO. OF					_		305	≥171 or	A		В		C		D	)	E	}		F	T
	REACH	STRUC. STUDIED	NO. OF RESI.	NO. OF COMM.	NO.OF APART.	NO.OF	0 <b>-</b> 76	77 - 124	E 125 -	SPECIAL CASES	1936	SPF	1936	SPF	1936								
-30	- I	8	1	1	0	6	0	0	0	8	0	0	0	0	0	0	0	0	7	7	1	1	G
Ĭ	2	37	3	27	7	0	0	7	4	26	0	0	19	18	0	0	2	4	1	5	<b>1</b> 5	5	С
	3	155	41	45	65	4	1	16	48	90	٥	0	103	50	1	1	11	48	1	6	17	2	22
	TOTALS	200	45	73	72	10	1	23	52	124	0	0	122	68	P-1	1	13	52	9	18	33	В	22

TABLE III
FLOODPROOFING COSTS

and the second s	I	LOOI	OPROOFING T	ECHNIQU	JE		<del>add Agas (Meinicine) (Meinice)</del>		and the state of the great production of the state of the
(PERIMETER FT.) SIZE	(DOLLARS A	PER B	PERIMETER C	FT.) (I	LUMP D	SUM	COST IN E	THOUSAND F	DOLLARS) G
0 - 76	37	64	71		12		Indi	0	Indi
77 - 124	35	59	63		14		or otd	0	or Vid
125 - 170	34	57	61		16		lual c	0	each each
≥ 171	35	56	61		18		ស្គ ខ ខ	0	9 8 8

TABLE IV
FLOODPROOFING COST ACCORDING TO REACH

REACH	NO. OI	F CASES	COST	r in
NUMBER	1936	SPF	1936	SPF
1	7	7	314.3	314.3
2	22	32	387.1	<b>477.</b> 5
3	138	153	2063.0	2734.5
TOTALS	167	192	2764.4	3526.3

TABLE V
FLOODPROOFING COSTS ACCORDING TO CATEGORY

CATEGORY		OF SES		T IN SANDS		ST PER CASE USANDS
	1936	SPF	1936	SPF	1936	SPF
Residential	40	42	335.2	616.9	8.38	14.69
Commercial	56	68	973.9	994.1	17.39	14.62
Apartment	61	72	726.3	1177.3	11.91	16.35
Industrial	10	10	729.0	738.0	72.9	73.8
TOTALS	167	192	2764.4	3526.3	16.55	18.36

## III. CONCLUSIONS

Included within Table IV is a summary of floodproofing costs for the entire study area according to reach number. This report estimates a project cost of approximately 2.8 million dollars (\$2,800,000.00) for the 1936 Flood levels and 3.5 million dollars (\$3,500,000.00) for the Standard Project Flood levels.

A review of Table V indicates that commercial property (and industrial complexes) constitute the largest portion of the total project cost for both flood levels studied. The financial impact to the commercial and industrial properties (and to the Town of Leominster) as shown in Table IV is only a small part of the true cost of non-structural flood damage prevention.

This report did not attempt to estimate the costs of acquiring businesses and property for structures found to be impossible to floodproof and therefore assumed they required demolition; the cost and availability of commercial and industrial property to relocate businesses which would require demolition of structures and subsequent relocation; or the practicality of relocating a commercial business with its viability dependent upon location.

Several major estimates and assumptions were made within this study which may have a large effect upon the actual final project cost should such a project be instituted. The following represents some of these estimations and assumptions made during this study:

A. The study areas of this report are limited solely to the areas delineated for the 1936 and the S.P.F. flood levels as shown on Sheet 1 in the Attachments. Our field investigation revealed the possibility that additional areas, other than those shown, may possibly be affected by the two flood levels. Specifically, the area south of Pleasant Street and Franklin Street, and the area between Lancaster Street and Central Street. Further analysis of these areas may indicate additional structures that would require floodproofing.

B. It was assumed that wooden structures being inundated above the first floor elevation from one to three feet could be raised (this could only be verified after an in-depth structural analysis of the building). Structures falling in this category would be floodproofed using Technique C in combination with sealing the doors and windows in the foundation wall. This assumption may not be in accordance with local fire codes or the owner's wishes. Alternate floodproofing techniques may prove more expensive than the above method.

Structures, primarily commercial, being inundated above the first floor elevation from one to three feet were reviewed on a case by case basis. It is impractical to assume that a masonry structure, generally constructed on a slab, could be raised. Therefore, each structure was reviewed to see if an alternate method of floodproofing were possible, such as placing shields over windows or construction of berms or concrete walls. If no practical solutions were apparent,

an estimated cost for demolition of the structure was made and entered in Table I.

- C. Structures which had a depth of inundation in excess of three feet above the first floor were assumed to require demolition. Further analysis of the structures and additional cost studies would be required to evaluate if the structure could physically be relocated and if vacant property is available.
- D. Depths of inundation in structures caused by the two flood levels studied often required estimation and interpolation of water surface elevations known from historical records or from hydraulic analysis of the Brook conducted in other studies. Estimation of flood levels is particularly difficult for the Monoosnoc Brook area because of the physical changes that have occurred (structures added or removed, channel changes, etc.) along the Brook not only since the most recent hydraulic analysis of the Brook but since the March 1936 Flood.
- E. A factor which affects a large number of structures within this study is the item involving the waterproofing of the outside of basement walls. For this investigation, it was assumed that all structures in fair to excellent condition, with no visible sign of occupancy have finished basements with storage. In many cases, the basement walls are actually unfinished rough concrete. A savings may be seen by the elimination of the required outside trench should it be determined that such structures could be waterproofed from the inside. It may also be found that the proposed trench excavation may not be possible

without affecting the structural integrity of the building. This could be due to the nature of the material making up the foundation, the overall condition of the foundation or the layout of the foundation which may prevent access. Should such a situation occur, the final solution may cost much more than the estimated cost herein.

F. The final factor which could have the largest effect upon the success of the non-structural project is the cooperation of the people who would be affected. Should these people offer little or no cooperation, the projected implementation time would be increased and new solutions may have to be sought. Such actions would change the project costs significantly.



#### APPENDIX A

## 1. 52 Mechanic Street

The rear of this structure is subject to flood waters both for the 1936 Flood and the S.P.F.

To floodproof this structure would require closing a rear access door adjacent to the brook. The estimated construction cost for the above floodproofing is \$3,300.00.

### 2. 38 Spruce Street - Tilton & Cook, Inc.

This well-maintained concrete block building sits astride the river with approximately four feet of clearance over the brook. If the opening under this building were to become blocked, significant damage to Tilton & Cook, Inc. would be incurred. There exists a possibility that approximately sixteen feet of water would be forced against the upstream section of the building.

There is no method of waterproofing available to prevent significant damage to the structure that spans the brook. It is, therefore, recommended that the structure spanning the brook be removed and the buildings attached to this section be bricked and waterproofed. The estimated total cost for demolition and additional construction would be \$ 42,000.00. (See Appendix C and Special Structure Photos in the Photo Set)

## 3. 40 Spruce Street - Bay State Plastics

This complex would be subjected to water in excess of three feet. The structures adjacent to the river consist of concrete block and one structure is a sheet metal clad building. For purposes of this study, we include costs for demolishing these brook-abutting structures and for retaining those buildings of substantial nature or those considered as not being subject to flooding.

To protect the substantial structures remaining would require the installation of an earth berm with rip-rap protection from a point beginning at the rear of the Tilton & Cook, Inc. complex and proceeding easterly. The estimated total constrution cost for the above floodproofing is \$83,000. (See Appendix C and Special Structure Photos in the Photo Set)

The remaining complex would require piping changes as well as the installation of a pump and sump to effectively dispose of surface runoff within the remaining buildings. While the impact on the present function of this complex would be severe, no costs have been included for this purpose.

## 4. 71-75 Water Street - Art Plastic Company and Cardinal Comb.

Immediately below the railroad bridge and in direct line of turbulent flow is the concrete block face of this complex. Parallel to the southerly face of the building is the river which enters a culvert under the Tilton & Cook parking lot. A section of retaining wall has been constructed westerly along the river when the owner developed a truck dock and parking area. This area is at El. 374±.

Protection for this structure would require a retaining wall from the northerly abutment of the railroad stone arched bridge to the face of the building. The height of wall at the bridge would be about El. 384 and at the building would be about 378. The existing wall would have to be removed.

The southerly portion of the building is assumed to be capable of withstanding the impact and height of flooding for purposes of this estimate. The wall would require floodproofing and the installation of a partial shield at the southwesterly corner of the building. The estimated construction cost for the above flood protection is \$23,000. (See Appendix C and Special Structure Photos in the Photo Set)

## 5. 100 Water Street - C.A.P. Moulding

This complex consists of several different type structures. The southeasterly portion of the building is concrete block on concrete slab. The separate building south of the main complex is also concrete block.

To protect this complex against flooding would require the construction of an earth berm from the east corner of the concrete building, thence southwesterly to the westerly corner of the separate building. Along the fence line between the Tilton & Cook complex would require a concrete wall to El. 366. Flood shields would be required at the entrance on Water Street.

To protect the complex from overland flow along Water Street, should it occur, would require removable shields on three doors and six windows fronting on Water Street. The north-easterly side of the structure facing the river would be flood-proofed to El. 360 at the northeast corner and diminish to El. 358 at the corner adjacent to the Water Street Bridge. The estimated total construction cost for the above flood protection is \$37,000. (See Appendix C and Special Structure Photos in the Photo Set)

## 6. 102 Water Street - Mock Furniture

This complex consists of several different type structures, however the major buildings fronting on Water Street and adjacent to the Rochdale Dam are brick. Northerly of the dam, the windows have been sealed by plywood. The building adjacent to the dam, Building "B", has a finished floor of El. 356 and will not be subjected to flooding.

In order to protect the complex from overland flow along Water Street, should it occur, would require removable shields at the two entrances as well as floodproofing the basement of Building "A" and installation of removable shields over four basement windows on this structure. No protection is required on Building "B" other than floodproofing the lower two feet of foundation along Water Street. The estimated total construction cost for the above floodproofing is \$10,000. (See Appendix C and Special Structure Photos in the Photo Set)

## 7. 124 Water Street - Industrial Complex

This major industrial complex has approximately eight tenants at present. Buildings range from wood frame to brick of various heights. Only those structures fronting on Water Street and those encroaching on the river are effected by flooding.

Building #5. is a wood structure with the lower level at approximately El. 342. The close proximity of the dam precludes construction of a concrete retaining wall for protection. The maze of wooden structures westerly of Building #5 are in poor condition because they abut the river and cannot be protected without undermining the present granite foundations. It is recommended that these structures be demolished. However, the remaining cinder block buildings could be protected from a flood. In order to protect this facility against the standard project flood it is suggested that the following protective measures be undertaken: construct an earth berm with rip-rapped face from the entrance to the complex westerly and northerly to the face of Building #1A. Building #1A would be waterproofed along the westerly and northerly side. Flood shields would be installed at the complex entrance and along the Water Street face of Building #7. The estimated total cost for demolition, earth berm, waterproofing and flood shields is \$93,000. (See Appendix C and Special Structure Photos in the Photo Set)

## 8. 12, 14, and 16 Central Street

This group of three stores consists of two buildings: a brick faced, slab-on-grade structure housing two of the stores and an adjacent concrete block, slab-on-grade structure housing the third.

At S.P.F. these structures are subject to one foot of inundation. Since it is physically impossible to raise these structures without damaging them, it would be necessary to install removable flood shields at all entrances and to apply waterproofing to the lower two feet of the exterior structure wall to floodproof these stores. This work would cost approximately \$4,000.

## 9. 18, 20, and 22 Central Street

This group of structures consists of two buildings: a concrete block, slab-on-grade structure housing a store and a restaurant and an adjacent slab-on-grade wood structure housing the Salvation Army.

At S.P.F., these buildings are subject to two to three feet of inundation. Since it is physically impossible to raise these structures without incurring damage, for purposes of this study these structures are included for demolition.

### 10. 40 - 46 Mechanic Street

This structure, which houses two businesses, consists of a concrete block, slab-on-grade structure with a brick and glass front.

At S.P.F. this building will experience one foot of inundation. Due to the nature and function of the structure, it would be best to install removable flood shields at all entrances and to apply waterproofing to the lower two feet of the exterior walls to floodproof this structure. The cost of this work would be approximately \$3,000.

### 11. 17, 19, 21, and 23 Water Street

This area consists of four structures, three of which abut each other (17, 19, and 21). #17 Water Street is a one story brick structure with a basement. #19 Water Street, abutting #17, is a three story brick building with cellar housing a radio station. #21 Water Street, adjacent to #19, is a diner with a metal-clad wood front section and a brick rear section. #23 Water Street stands separate from the last three addresses. It is a service station for B & M Taxi, constructed of concrete block set on a slab-on-grade with a large surface area of its front walls taken

up by glass and an overhead door.

All of these buildings abut the waterway, with the rear basement wall of numbers 17, 19, and 21 also serving as channel walls. At S.P.F. only the basements would be subject to flooding. In order to floodproof these four buildings, #17 Water Street is the only structure requiring work, assuming for the purposes of this study that the existing channel walls are structurally adequate and waterproof. #17 Water Street would require the removal of existing and totally deteriorated glass block windows and the blocking up and waterproofing of the resulting openings. The estimated cost of this work is \$12,000.

## 12. 91/93 Adams Street

This building is a two story, wood frame, two family house in relatively poor condition. At S.P.F. this structure cannot be waterproofed since the foundation is constructed of wood, allowing the relatively free passage of water under flood conditions into the cellar area. An earth berm or dike is not practical in this location due to the proximity of adjacent homes, nor would it be possible to raise the building's foundation without causing damage to the structure.

For these reasons, the above house is included for demolition for the purposes of this study.

#### 13. 121 Adams Street

This structure is a one story, wood frame, slab-on-grade building housing a bait shop and a glass and screen merchant. At S.P.F. this building would be inundated with three feet of water. Due to the type of foundation and wood frame walls, building water-proofing or raising the foundation is precluded.

For these reasons, this building is included for demolition for the purposes of this study.

#### 14. 140 Bowen Place

This structure is a four story, wood frame factory in relatively poor condition with a masonry block foundation penetrated by windows at approximately eight feet on centers. There is also a brick boiler room (one story) attached to the back of the building.

At both the 1936 and S.P.F. flood levels this structure is subject to flooding. Due to the presence of the many windows in the foundation and the wood frame structure itself, it is doubtful that either waterproofing the basement level is practical or raising the foundation is possible.

For these reasons, this structure is included under demolition for the purposes of this study.

## 15. 11-17, 21-27, 75, 91-95 Central Street

11-17 Central Street is a slab-on-grade, concrete block, one to two story structure with a brick and wood facade. A portion of the rear of this structure is one story wood frame. 21 Central Street is a wood frame, slab-on-grade one story structure housing an auto parts store. 23 and 25 Central Street is a brick and glass facade built onto an older two story wood frame structure with a basement. The front portion serves to house businesses. 75 and 91-95 Central Street is a wood frame, slab-on-grade, two to three story structure with a brick and glass facade housing a furniture and variety store.

Under the 1936 Flood, these buildings are subjected to a mean inundation of two feet above the first floor and under the S.P.F. to a mean of six feet. Due to these depths of inundation and the types of structures involved, raising foundations and waterproofing is not feasible.

Therefore, for the purposes of this study, these buildings are included for demolition.

## 16. 65 Cottage Street

This building is a two story wood frame house with a third level below at the back of the house where the grades drop away from the road. This lower level is presently used as an office.

To protect this lower level under S.P.F., which would be subjected to four feet of water, it would be required to construct an earth berm around the building and garage. The cost of this work is estimated at \$26,000.

### 17. 83 Cottage Street

This building is a one story concrete block structure constructed on an elevated slab, used as a truck-loading terminal.

At S.P.F., this structure would be required to be raised for flood-proofing, due to the number of overhead doors that would inundated. Waterproofing would not be feasible for this type of structure. For the reason that this structure could not be raised without damage to its integrity and function, it is included under demolition for the purposes of this study.

### 18. 21, 23-33, 35 Monument Square

21 Monument Square is a one story, slab-on-grade brick and glass building housing the Leominister Savings Bank. 23-33 is a two story brick structure built on a concrete slab. 35 Monument

Square is a one story brick structure, constructed on a concrete slab housing an insurance company.

At S.P.F. these structures will be inundated by about one foot of water. Due to the nature and function of these structures, it would be best to install removable flood shields at all entrances and utilize the flood proofing techniques indicated in Table 1. The cost of the flood shields is estimated at \$5,000.

#### 19. 23 Pleasant Street

This building is a one story, slab-on-grade brick structure housing a coffee shop.

At S.P.F. it will be subject to approximately one foot of water. The floodproofing technique recommended for this structure is to install removable flood shields at entrances and to utilize the floodproofing techniques presented in Table 1. The cost of the flood shields is estimated at \$1,000.

#### 20. 71 Pleasant Street

This structure is a two story wood frame structure with a concrete foundation and a brick facade, which houses various medical offices.

At both 1936 and S.P.F. levels, the lower floor of this structure would experience flooding. Due to the size and characteristics of this structure, raising its foundation is not feasible. Thus, for the purposes of this study it is included under demolition.

### 21. 83 Pleasant Street

This structure is a two story, wood frame, slab-on-grade structure adjacent to the channel.

Under the 1936 Flood and the S.P.F. this structure will be subjected to one foot and five feet of water respectively. Due to the nature and function of this structure, it is not practical to either waterproof or raise the foundation of the structure.

For these reasons, this structure is included for demolition for the purposes of this study.

### 22. 158 Pleasant Street

This structure is a three story, wood frame structure presently used as a factory. Due to the composition of the building, it is not feasible to consider raising the foundation or waterproof the structure.

In order to protect this facility against S.P.F. it is proposed to construct an earth berm from Pleasant Street, southeasterly

two hundred feet to the rear of the property, thence southwesterly two hundred feet to the westerly boundary, and thence Northwesterly two hundred feet to Pleasant Street. Included in the cost of this work is the cost of a sump and pumps. Berm would be constructed to El. 402. The cost of this work is estimated at \$75,000.

23. 95 Adams Street Paragon Plastic
98 Adams Street Commonwealth Plastic
No address Thom McAn Warehouse

This complex of buildings are interconnected and consist of one and two story slab on grade industrial buildings. Thom McAn warehouse is a two story concrete block structure and the truck dock of Paragon Plastic is also concrete block. This structure abuts the brook.

Under the 1936 flood, these buildings are subjected to a mean inundation of two feet above the first floor and under the SPF to a mean of five feet. Due to these depths of inundation and the types of structures involved it was not considered feasible to provide protection in either case.

Therefore, for purposes of this study, these building are included for demolition.

APPENDIX B

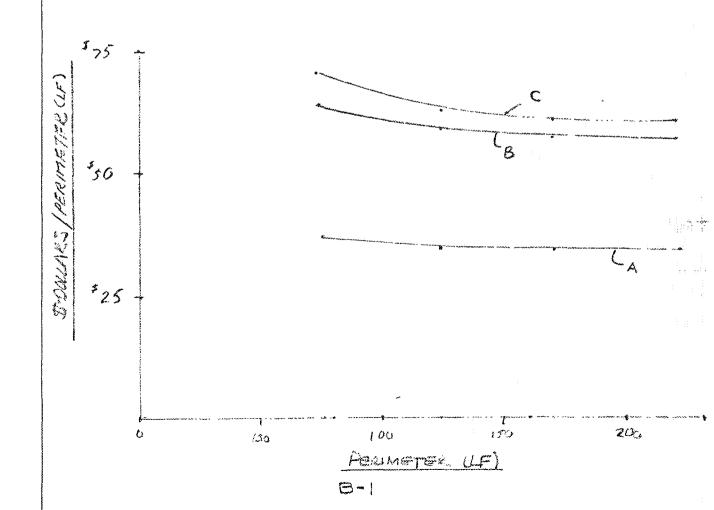
OB NO 783/2./
ATE 2-22-79
BY JRISTAN
HO BY R. CONCE

HAYDEN, HARDING & BUCHANAN, INC CONSULTING ENGINEERS BOSTON, MASSACHUSETTS JOB LECTIONSTEP

SUBJECT Flood Proofing

CLIENT CO.E.

	SUMMARY	OF COST F	TACTORS		
HOUSE	PERIMETER	TYPE OF	FLOODP	ROOFING	8 1
SIZE	(H)	( DOLL		NETER PT.)	
		<u>À</u>	_'B		D
18×20	76	36 93	64 37	7/28	12,000
26'×36'	124	35 27	5883	63 06	14,000
35×50'	170	34 <u>06</u>	56 50	60 <sup>20</sup>	16,000
50'x62'	224	3466	5635	6193	18,00C



SHEET NO 205 LA JOB Leaminster
BUBJECT Flood Proofing CLIENT \_\_ C.O.E

(Wege Rates From "Means"-Include OH & P.)

II. FLOODPROOFING - ZLO'X ZLO' HOME (Perim = 124 feet)

## A. DRAINS & SUMP PUMP

1. Breaking up slab around cellar floor Rent or compressor @ \$50/day xzdays 1 worker for zdays; 16hrs @ \$14.00/hr (Includes deenup) \$ 334

z Hard excevate tranch, remove matil from cellar, load & have away Assume; z man craw 6 \$31.50/hr Trench z'dp. x z'wd @bese, 1/2 sides

> 1/2 (4+2) 2 = 6 59, ft. Inside penm. 2 from wall: 100 Volume = 648/27 = 24 cy.

Assume: 2/aborers candy 12 cy/day
2 " move 24/cy/day

2 days diging @ 1 31 5/crew x 8 holdey I day loading @ 1 31 5/crew x 8 holdey

Person ter 1 4 hrs 6 4 34/hr

3. Backfill - crustral stone 24 cy. @ 16/64. (mat')) 5 hrs labor @ 44.60/hr \$ 1,027 \$ 144.

+ 50-

252

135

\$ 100.

234

7 ZLO1.

18:	٠	<u> </u>	رج .	2	1
<b>\TE</b>		2/2	2	175	<del>)</del>
BY	_8	B			Cart.
C.H.D	8Y _	J.	Pla	77	

# HAYDEN, HARDING & BUCHANAN, INC. CONSULTING ENGINEERS BOSTON MASSACHUSETTS

3	SHEET NO	11/4
JOB 🚣	econostrer	APPL
SUBJECT	Flori Pro	3 - 1 C
CLIENT .	CO.F.	<b>~</b>

	•
4. 6" V.C.P. 108 1f. @ 44/1f (including installat	iai) 443
5. Replacing Concrete  4' × 4/12 +hk. × 108 1.f./27 =  5/3 cy @ \$110/cy	
6. Sump Romp, Hose, Install Gutlet.	strong strong of
7. Clash up, Replace tiles, etc. shro @ \$14.60/hr	117.
TOTAL	~ φ3,0≥
WATERPROOF WALLS	
1. Excevete Trench Arand Houses Assume: 3.5' wd x c'dp. Outside perin: 140' (2' from well) Volume = 3.5 x bx 140/27 = 109 cy @ +2.60/cy	
z. Clean Walls, Apply Waterproofing B' ht x 124 perm = 902 of @ \$1./of	99 Zan
3. Backfill Trend. W/ Composition. 109 cy (\$ \$3.60/cy.	and the same of th
4. Restore Site (Clearly, Replaces Shrubs, Firmers, etc.)	Since the second of the second
TOTAL TA E TE	- <sup>†</sup> 2 029

SHEET NO 40F4

I GASA

## C. BLOCK UP WINDOWS

- Remove Exist Windows Assume: buindows @ zhro labor/20. 12 hro. @ 414.40/hr 4175.
- 2. Material Concrete Blocks
  6 windows x 16"x 32"/ea/14" =
  21 5.f. @ 40,70/5.f

3. Installation
Assume: | Bricklayer & tis. 55/hr

1/2 hrs x 6 x \$18, 55 = \$167

Use Same As For Removal 175

TOTAL \$365

TOTAL PART IA: \$ 3,030.

"I IB: 2,039

"I IC: 365

TOTAL PART II; \$5,430,

## II. RAISING FOUNDATION

A. EXISTING CELLAR - 2 story, 24'x 34' ave from

Heating, sewer, water, gas, electric, telephone etc. lines must be cut of extended, junction boxes installed, etc.

Z. Underpinning - Jacking

Mobilization

Estimate to cut walls, underpin, jack

up, place cribbing, etc.

Labor: 3days - Zmechanics, 3/aborers

Mechanics: \$21/hr x 3x8x2

Laborers: \$146/hrx3x8x3
Equipment Rental For Duration

Pour or lay new foundation, fix all stairways, fix or pour new floor slab.

Assume:

- 3' foundation XIZH perm (new felon walls) @ \$3./sf.
- Stairways & slab (Assume I mason & helper)
\$\delta \text{25} \text{(combined)/hr x Zdaysx8}

\$1,648

4700

1,00

1,05

1,200

\$ 3,95

BUBJECT Flood Aconin CLIENT COF

- 4. Materials Lines, pipes, brick/block/concrete, etc. Estimate L.S.
- 5. Restaration Clean up, shrubs, lawn, plaster cracked walls, restore basement, repair porches, etc.
- 6. Care for Occupants
  Howing for duration, moving of valuables, etc.

Assume: ender duration (a) 4 45 /day

TOTAL -

TOTAL PART I : \$ 5,430. TOTAL PARTIEA: 10,632 TOTAL PARTS IA IB IC & IIA: \$ 16,062

\$3,034. Cpg. ?

## Carried and find

CASE "A" - DRAINAGE SYSTEM WITH SUMP FUMP (See pp. 142 : IA)

> Rew Cost! 10% Contrigencies:

304. 73,340. 044P(10%); 304.

General Contractor's OH&P (10%):

# 3,444.

Engineering of Survey (20%):

4 4 373.

COST / PERIM, FT. = \$4,373/24 = \$35.27/4.

CASE "B"-DRAINAGE SYSTEM, SUMP PUMP & WATERPROCESING (SPER PS) 142, IA & IB)

PAW COST : 10% Contingencies :

General Contractorio OHOP (10%):

\$ 5,57c. \$ 507 \$ 6,079.

Engineering & Survey (20%):

1,216.

\$ 7,295.

COST / DERIM FT. = \$7,295/124 = \$58.85/ Ft.

8 1	10 75	3 - 3	312.	L
TE		122	179	
вү	RK		23	- Company 1
CH.D	вү 🚐	E1	THU	<b>5.</b>

# HAYDEN, HARDING & BUCHANAN, INC. CONSULTING ENGINEERS BOSTON MASSACHUSETTS

SHEET NO SUF 4

BUBJECT FLOW HOSTING

CLIENT C.O.E.

CASE "C" - DRAILLAGE SYSTEM, SUMP PUMP, (See pp. 1-3: IA, IB & IC) (٥، ١٩١٥) رهاره Raw Cost : 10% Contingencies: 45,973. General Contractor OHAP (10%): \$6,516. Engineering & Survey (20%): 1,303. \$7,819. COST/PERIM. FT. = \$7,819/124 = \$63.06/ft. CASE "D"- RAISE HOUSE (SEE HOUSE, ITA) ೆ10,632. (ಅ.ಕ) Raw Cost: 10% Contingencies ! \$11,003. \$11,095. General Contractor OH&P(10%) 1,063. 312,758

LUMP SUM - +14,034.

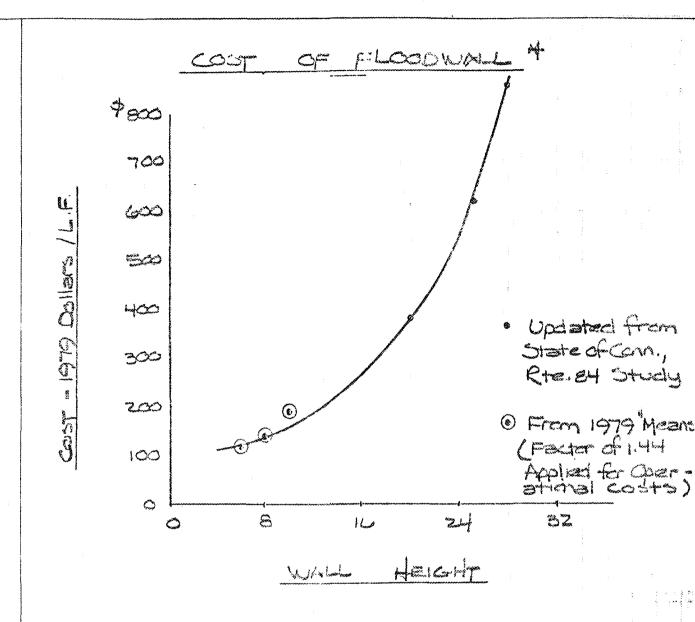
1,276.

Engineering & Survey (10%)

JOB LECTION TOP Y

SUBJECT FINE WALL

CLIENT COSE



\* Flactivell considered is reinfried concrete contileve, including all materials, installation of operational extra s.

## HAYDEN, HARDING & BUCHANAN, INC.

BHEET NO 10684 108 Leoninster SUBJECT Flood Proches CLIENT COE.

## cost of Flato shields

Material

Assume: 3'x 3/z' gate, "4" thk. aluminum shield Volume: 3'x3'2'x 14/12 =0.22 cf Unit Wt: 1US pef Total Weight (Assume 2 x what gate

for all brackets of fixitures) 0.22 fx 16 = pef x 2 = 72# @ \$ 2.50/10.

Installation

Assume: A crew of Imason & I helper can motal 1/2 chiefs /day, or approx.

6 hrs @ (\$18,555+14.00)/hr

4 180

tam, Raw Total ! 10% Contingencies ; Contractor of CHAP (10%): 35

Engineering (20%):

dishe.

use deso/Shield

3 NO TA - 3/2 | BY R.K. 13-3/2 | C D BY J. (1984)

# HAYDEN, HARDING & BUCHANAN, INC. CONSULTING ENGINEERS BOSTON MASSACHUSETTS

SUBJECT FLOOD PROFING
CLIENT C.O.E.

(Wage Rates from "Means" - Include O.H. & A)

I FLOODPROOFING 18'x20' House (Perm = 76')

## A. DRAINS É SUMP PUMIP

Prealing up slab around cellar floor

Pent air compressor @ \$50/day for Iday \$50.

I Worker for Iday: \$14.0/hr x 877day 117.

\$107.

2. Hand Excavate Trench, remove matil
from celler, load of haul away
Assume: 2 man work crew 6 \$31.50/hr
Trench zidp, z'wd 6 base,
1:2 oldes

12(4+2) 2 = 6 xg, ft. Inside perim 2' from well: 60' Volume = 36/27 = 13 64'

Assume: 2 laborers candig 12 cylday

1 day diaging @ 431 50/hr x should y /2 day diaging @ 431 50/hr x should y

Darp Trusk (sed) @ \$ 135/de Aller Al

E. Packfill - crushed store
I'll cy @ \$6/cy (matil)
6 his later @ 44.60/hr

8-11

126

135

1649.

\* 84 <u>88</u> †172.

BNO	<u> </u>	2-3	12.1	
,TE		221	79	
ву	R.K.	<u>O</u> z	عصابح	<u> </u>
PD E	سسر ۲۶	J. ()	37211	

# HAYDEN, HARDING & BUCHANAN, INC. CONSULTING ENGINEERS BOSTON MASSACHUSETTS

JOB LECONOSTEC
SUBJECT FLOOD PROFILE
CLIENT CO F

4. 6" V.CP  GOIF @ 4 4/1f. (including installation)	+ 2-40.
5 Replacing Concrete  4'x 1/12'x 60 1f /27 =  3 cy @ \$110/cy	350
6. Jump Rump, Hose, Install Outlet	275
7. Clean up, Replace tiles, etc. e hrs @ \$14.60/hr	117
TOTAL	- \$1,950
B. WATERPROOF WALLS	
1. Excepte Trench Around House Assume: 3.5'wd xw'dp. Outside perim.: 100'(2'from wall) Volume - 3.5'xw'x100'/27 = 78 cy @ \$ 2.80/cy	\$ 21B
2. Clean Walls, Apply Waterproofing 8'ht x7u' perim = 600 s.f. @ 41/s.f.	4 GE
3. Backfill Trench w/ Conjection 78 cy. @ \$3.60/cy	281
4. Re-drive Site (Clear up, Beplace Strains, Fences, etc.)	<u> </u>
TOTAL IA 4 IB	- \$ 1,447, - \$ 3,397

## HAYDEN, HARDING & BUCHANAN, INC. CONSULTING ENGINEERS BOSTON MASSACHUSETTS

SHEET NO 130F44

JOB LEOMINGTON

BUSIECT FLOOR AROUND

CLIENT C.O.E.

## C. BLOCK UP WINDOWS

1. Remove Exist Windows Assume; 6 windows @ 2 hrs. labor/ea. 12 hrs. @ \$ 14.60/hr.

\$ 175

2. Material - Concrete Blocks 6 mindaus x 10"x32"/ea/144 = 21 s.f. @ \$0.0/s.f.

-

3. Installation
Assume: I Bricklayer @ \$10.55/hr.
1/2hroxux \$18.55/hr = \$167.
Use Same As For Removal

175

TOTAL AART II; \$3,762.

JOB LECTOR TO THE SUBJECT FLOW FOR THE STATE OF THE STATE

## III. RAISING FOUNDATION

## A EXISTING CELLAR

Heating, sewer, water, gas, electric, telephone etc. lines must be cut é existended, junction boxes installed, etc.

Elevate structure - Cut walls,

Jack , place cribbing, etc.

Labor: 2 days-2 mechanics, clairers

Mechanics: \$21/hr x 2 x 6 x 2

Laborers: \$\frac{1}{2}\text{H.M.M.hr x 2 x 6 x 2} \tag{701}

Equipment Remial For Duration 1,200

\$3,273,

3. Masonny
Pour or law new foundation fix all
stainways, fix or pur new floor slabs

Assume:
-3' foundation x 70' perin (new folin

walls) @ \$3/5f

- Stainways of slabs (Assume
I mason of helper)

+32,29 (combined)/hrx//dens x8 3

JOB LETTING 150F4

H. Materialis Lines, pipes, brick/block/concrete, etc. Estimate Lis. 4225.

Seederation
Clean up, should, lawn, plaster cracked
wells, restare basement, repair
portion, etc.

250

L. Care for Guypants
Housing for duration, moving of
Valuables, etc.

Assume :

30 day duration @ नेपड विक्य 1,050

TOTAL PART JA: 43,762.

TOTAL ANTO INTERT CHAIT 12, 843.

SHEET NO 16 OF 41

JOB LEMICATICE
SUBJECT FLOOR PROPRING
CLIENT C.O.E.

## حروص

CASE "A" - DRAINAGE SYSTEM WITH SUMP PUMP (See pp. 10411, TA)

Raw. Cost : 41,950 (pg.11)
10% Contingencies: 195
General Contractor OHAP (10%); 195
\$72,340
Engineering & Duney (20%) 42,606.

COST / PERIM, FT = \$2,835/76 = \$34.95/FF.

CASE "B"- DRALAGE SYSTEM, SUMP PUMP & WATERFROOFING (See AP 10411, IA & FB)

Raw Cost: \$3,397. (pg.11)
10% Contingencies: 340.

General Contrador OH &P (10%): 340.

\$41,077.

Engineering & Survey (20%) 515

\$41,892.

COST / PERIN . FT = \$4,892/16 = \$64.87/f+

SUBJECT FICOM POSTAGE

CASE "C" - DRAINAGE DYSTEM, SUMP PUMP, NATER PROPRIES & BLOCK UP WILLOUS (See pp. 10-12; IA, IE & IC)

> \$3,762. (B.12) Raw Cost 1 10% Contingencies: General Contractor CH&P(10%) 376. Engineering of Survey (20%): \$ 5,417.

COST / PERIM. FT. = \$5,417./76=\$71.28/ft.

CASE "D" - RAISE HOUSE 3 FEET

49,081 Raw Cost! 10% Contingencies : 908. General Contractor OH&P(10%): 908 \$10,897. 10% Contingencies " Engineering & survey (10%): 1,090. Lump SUM--- 11,987.

)B NO _	73-312.1
DATE	7. / 2.2 70
BY	F. D.D.
H'D BY	_ D RICTAU

# HAYDEN, HARDING & BUCHANAN, INC. CONSULTING ENGINEERS BOSTON MASSACHUSETTS

JOB SUBJECT FROM PROFING
CLIENT C.C. F.

Wage Rates from "Means" Incl. OfP

I Flood Proofing 35' by 50' House

Perimeter = 170 Feet

A. Drains & Sump Pump

1. Break up slab

Air compressor rented @ \$50/day for 2 days

1 worker for 2 days = 16 hrs. @ 14.60/hr.

\$100. \$234.

2. Hand excavate trench, remove material from cellar, load & haul away

Assume: 2 man work crew @ \$31.50/hr.
Trench 2'deep, 2'wide @Bot., 1:2 slope

 $\frac{1}{2}(4'+2')2' = 6 \text{ ft}^2$ Inside perimeter 2' from wall = 154' Volume =  $\frac{6 \times 154}{27} = 34.2 \text{ c.y.}$ 

Assume: 2 laborers can dig 12 C.Y. /day
2 " move 24 C.Y. /day

3 days digging @ \$31.50/crew x8 hr. 11/2 days loading @ \$31.50/crew x8 hr.

\$756. \$378.

Dump Truck (6 C.Y.) @ \$135.00
Pay Loader 4 hr @ \$34./hr.

\* 135. \* 136.

3. Backfill - Crushed Stone 34 c.y. @ \$6.00/c.y. Material 12 hrs. labor @ 14.60/hr.

<sup>\$</sup> 204. <sup>\$</sup> 175.

8-18

ON BC	78-312.1
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ρY	F. D. D.
H'D BY	J. RISTAU

## HAYDEN, HARDING & BUCHANAN, INC CONSULTING ENGINEERS BOSTON MASSACHUSETTS

BHEET NO 19674

4. 6" diameter VCP 154 LF @ 4.00/L.F. (including installation)

<sup>\$</sup> 616.

5. Replacing concrete

4' × 4/12' × \frac{154 L.F.}{27} = 7.6 C.Y.

@ \$110, /C.Y.

€ 837.

6. Sump Pump, Hose, Install Outlet

L. S.

\$ 275.

7. Clean-up, Replace Tiles, etc.

12 hrs. @ \$14.60/hr.

\$ 175. Raw Total \$ 4,021.

## IB. <u>Waterproof Walls</u>

1. Excavate trench around house
Assume: 3½ wide
6' deep
Outside perimeter = 194 L.F.

Volume = 
$$\frac{3.5 \times 6 \times 194}{27} = 150 \text{ C.Y.}$$
  
@ \$2.80/c.Y.

\$ 420.

2. Clean walls, apply waterproofing 8'x 170 = 1360 S.F.

@ 1.00/S.F.

<sup>‡</sup>1360.

ON BC	78, 312.1
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н'о вү	J. RISTAU

# HAYDEN, HARDING & BUCHANAN, INC. CONSULTING ENGINEERS BOSTON MASSACHUSETTS

JOB Leaminster

SUBJECT Flood Proofing

CLIENT C.O. E.

3. Backfill trench with compaction 150 C.Y. @ \$3.60 /C.Y.

\$540.

4. Restore site (clean up, shrubs, Fences, etc.)

L.S.

\*340.

Raw Total \$2,660.

Total IA 4 IB

\*6,681.

IC Block up windows

1. Remove existing windows

Assume 8 windows @ 2 hrs. each

16 @ \$14.60/hr.

\$234.

2. Material - concrete blocks

$$\frac{8 \times 16^{8} \times 32^{8}}{144} = 28 \text{ s.f.}$$

$$0 = 4.70 / \text{s.f.}$$

# ~ ~

3. Installation

Assume bricklayer @ \$18.55/hr.
1/2 hrs. x 8 x \$18.55 = \$222.60 - use same
as removal

\$ 234.

Raus Total \$488.

Total IA + IB + IC

17,169.

B-20

08 NO	78.312.1
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	J. RISTAU

### HAYDEN, HARDING & BUCHANAN, INC CONSULTING ENGINEERS BOSTON, MASSACHUSETTS

SHEET NO. 21054

JOB Leominster

SUBJECT Flood Proofing

CLIENT C.O. E

## II Raising Foundation

1 Disconnect & Restore Lines

Heating, sewer, water, gas, electric, telephone lines must be disconnected extended, junction boxes installed, etc.

L.S. estimate

\$ 1,700.

2. Underpin Jacking

Mobilization

\$ 700.

Elevate structure - cut walls, jacking, place cribbing, etc.

labor: crew of 2 mechanics, 3 laborers
@ 2(\$21./hr) + 3(\$14.60/hr) = \$85.80/hr.

or 686.40/day

Assume 4 days @ \$686.40/day

\$2,745.

Equipment Rental for duration

\*1,200. Total \*4,645.

3 Masonry

Pour or lay new foundation, fix all stairways, Floor slab

Assume 3' foundation x 170 (Perim) @ \$3./s. \$1,530.

Stairway & slab 1 mason + helper @ 33.25/hrx8 hrs. x 3 days

\* 798

Total

_ ON BC	78.312.1
DATE	2122179
BY	F. D. D.
	T RISTAU

JOB Leaminster BUBLECT Flood Prosting CLIENT C.O.E

4. Materials

Lines, pipes, brick or block flor concrete, etc. \$225. Estimate L.S.

5. Restoration

Clean-up, shrubs, lawn, plaster, cracked walls, restore basement, porches, etc.

Estimate L.S.

\$ 1,150.

6. Care of occupants Housing during duration, housing of valuables, etc.

> Assume 30 days duration \$65. /day **@**

\$ 1,950.

Raw Total

\$ 11,998.

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עמית פע	J. RISTAU	

HAYDEN, HARDING & BUCHANAN, INC.

CONSULTING ENGINEERS
BOSTON MASSACHUSETTS

JOB Leaminster SUBJECT Flood Proofing

Costs.

## TYPEA

Drainage system with sump pump (IA)

Raw cost		\$4,021.
Contingencies C	10%)	\$402
General Contractor	is 04P(10%)	¥402.
Engineering & Su	irvey (20%)	* 4825. * 965.
	Total	\$ 5,790.

Cost per Perimeter Ft = \$5,790/170 = \$34.06/fi

## TYPE B

Drain system & pump + waterproofing (IA+IB)

Raw cost	<sup>‡</sup> 6,681.
Contingencies (10%)	<sup>#</sup> 668.
General Contractor's OfP (10%)	\$ 668. \$ 8,017.
Engineering & Survey (20%) Total	*1,603. *9,620.
Cost per perimeter ft= \$9,620/170=	\$56.60/s.

ON BC	78.312.1
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JOB Leominster SUBJECT Flood Proofing

### TYPE C

Type B + blocking up windows CIA+IB+IC)

\$7,169. Raw cost £ 717. Contingencies (10%) \$ 717. General Contractor's Of P(10%) \$ 1,721. Engineering & Survey (20%) \$10,323.

Cost per perimeter ft. = \$ 10,323./170 = \$60.70/Ft.

Total

## TYPE D (Excluding Type C)

Lump sum for raising Foundation

\$11,998. Raw cost \$ 1,200 Contingencies (10%) General Contractor's Of P (10%) \$ 1200 \$ 14,398 <sup>4</sup> 1440 Engineering & Survey (10%) <sup>1</sup>15,838 Total

Lump sum = \$15,838 - use \$16 thousand

SUBJECT Flood Proofing
CLIENT C.O.E.

Wage Rates from "Means" Incl. 0 & P

I Flood Proofing 50' by 62' House

Perimeter = 224 feet

- A. Drains & Sump Pump
  - 1. Break up slab
    Air compressor rented @ \$50./day for 3days \$150.

    1 worker for 3 days = 24 hrs. @ \$14.60/hr. \$\frac{4350}{500}.

    Total \$\frac{5}{500}.
  - 2. Hand excavate trench, remove material from celler, load and haul away

Assume: 2 man work crew @ \$31.50/hr.
Trench 2' deep, 2' wide @ bot., 1:2 slope

$$1/2 (4+2)2 = 6 \text{ ft.}^2$$
  
Inside perimeter 2' from wall = 208'  
Volume =  $\frac{6 \times 208}{27} = 46 \text{ C.Y.}$ 

Assume: 2 laborers can dig 12 C.Y. / day
2 "move 24 C.Y. / day

\$ 276. \$ 234. \$ 510.

SHEET NO ZECTH JOB Leaminstir SUBJECT Flood Proofing CLIENT C.O.E.

4. 6" diameter VCP 208 L.F. @ \$4.00/L.F.

\*832.

5. Replacing concrete  $4' \times \frac{4}{12}' \times \frac{208 \, \text{L.F.}}{27} = 10.3 \, \text{C.Y.}$ 

@ \$110/c.Y.

<sup>₫</sup> 41 33.

6. Sump pump, hose, install outlet

L. S.

\$ 400.

7. Clean-up, replace tiles, etc. 16 hrs @ \$1460 \$234.

Raw Total \$5,392.

## B Waterproof Walls

1. Excavate trench around house
Assume 3½ wide
6' deep
Outside perimeter = 250 L.F.

@ 280/C.Y.

\$ 543.

2. Clean walls, apply waterproofing  $8' \times 224 = 1792 \text{ s.s.}$ 

@ \$1.00 /s.F.

\$ 1,792.

08 NO	78.312.1
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BY	F.D.D.
	J. RISTAN

## HAYDEN, HARDING & BUCHANAN, INC. CONSULTING ENGINEERS BOSTON MASSACHUSETTS

SHEET NO 2/04

JOB Learning ter

SUBJECT Flood Proofing

CLIENT C.O.E.

3 Backfill Trench with compaction 194 C.Y. @ \$3,60 /C.Y.

\* 698.

4. Restore site ( Clean up, shrubs, Fences, etc.)

L. S.

\$ 340. Raw Total \$3373.

Total IA & IB

\$ 8,765.

IC Block up windows

1. Remove existing windows
Assume 12 windows @ 2 hrs. each

@ \$ 14.60 /hr

8350.

2. Material - concrete blocks

$$\frac{12 \times 16'' \times 32''}{144} = 42 \text{ S.F.}$$

$$0 = 3.70 / \text{S.F.}$$

\$ 29.

3. Installation

Assume Bricklayer @ \$18.55/hr 1.5 hrs x 12 x \$18.55 = \$334. use same as removal

1350.

Raw Total \$729.

Total IA+ IB+ IC

19,494.

38 NO	78.312.1
DATE	2122179
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SUBJECT Flood Prosting CLIENT \_\_ C.O.E.

#### Raising Foundation II

1. Disconnect & Restore Lines

Heating, sewer, water, gas, electric, telephone lines must be disconnected & extended, junction boxes installed, etc.

L.S. Estimate

\$1,700.

Underpin - Jacking

Mobilization

\$ 700 .

Elevate structure - cut walls jacking, place cribbing, etc. Labor: crew of 2 mechanics, 3 laborers @ 2( \$21,00/hr)+3(\$14.60/hr)=\$85.80/hr. or \$ 686.40 /day

Assume 5 days @ \$686.40/day

\$3,432.

Total \$5,332. Equiptment Rental for duration

3. Masonry

Pour or lay new foundation, fix all stairways, Floor slab Assume: 3' Foundation x 224 (Perim) \$3.15. 5 2,016. Stairway & slab Imason + helper @ 33.25/hrx 8 hrs x 4 days Total

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HAYDEN, HARDING & BUCHANAN, INC CONSULTING ENGINEERS BOSTON MASSACHUSETTS JOB Leominster

BUBJECT Flood Procting

CLIENT C.O.F.

4. Materials.
Lines, pipes, brick or block \$100 concrete,etc.

Estimate L.S.

\$ 450.

5. Restoration
Clean-up, shrubs, lawn, plaster, cracked walls, restore basement, porches, etc.

Estimate L.S.

\$1,450.

6. Care of occupants .
Housing duration, moving of valuables, etc.

Assume 30 days duration

@ \$ 65. Iday

\$1,950.

Raw Total \$13,962.

OB NO .	78.312.1
DATE	2122177
BY	FDD

## HAYDEN, HARDING & BUCHANAN, INC. CONSULTING ENGINEERS BOSTON MASSACHUSETTS

SHEET NO 300FYL JOB Leaminster SUBJECT Flood Prosting CLIENT C.O. 6.

## Costs

## TYPEA

Drainage	system	with	Sump	Pump	(IA)
----------	--------	------	------	------	------

Raw cost

Contingencies (10%)

General Contractor's Off (10%)

Engineering & Survey (20%)

Total

\*5,392.

\*539.

\*539.

\*6,470.

\*1,294.

Cost per perimeter ft. = #7,764 = \$34.66/4

## TYPE B

## Drain System & Sump + Waterproofing (IA+IB)

Raw cost

Contingencies (10%)

General Contractor's O & F (10%)

Engineering & Survey (20%)

Total

\*8,765.

\*877.

\*877.

\*10,517.

\*12,623.

Cost per perimeter ft. =  $\frac{f_{12,623}}{224} = \frac{$56.35/$ft.}{}$ 

28 NO	78.312.1	
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8Y	F.D.D.	
	T PISTALL	

# HAYDEN, HARDING & BUCHANAN, INC. CONSULTING ENGINEERS BOSTON MASSACHUSETTS

SHEET NO 510F 4

JOB LCOMINGTON

BUBJECT Flood Proofing

CLIENT C.O. E.

TYPE B	TYPEC  plus blocking up windows CIA + IB +	IC)
,	Raw cost	¥9,494.
	Contingencies (10%)	¥ 949.
	General Contractor's 04P (10%)	<i>⁴ 949.</i> <i>ᠯ 11,392.</i>
	Engineering & Survey (20%)  Total	* 2,278. * 13,670.
	Cost per perimeter ft = \$13,670/224 =	\$61.03/ft.
	TYPED (excluding Type C)	
Lump su	m for raising foundation	:
	Raw cost	<sup>4</sup> 13,962.
	Contingencies (10%)	1,396.
	General Contractor's Of P (10%)	\$\frac{1,396.}{16,751.}
	Engineering & Survey (10%) Total	* 1,675. *18,429.

Lump Sum = 18 thousand

SUBJECT Flood Profing

## COST OF FLORU BARRIERS

Install permanent ppe sleeve in graind.

Includes excavation, sleeve plecement,

granting, backfill, patching pavement

of grassed area.

Estimate Lump Som /Ea. 4100.

2. Flood Camer Frame

Jay 2 10' Section will be 10' 19x z'Ht.

Use 1/2" plyward on a frame of z'x3"'s.

Frame topd bottom, ends of insert a

stress diagonal.

Total Leight (2x3's): [2(10")+2/2")+10.2"]

3. Plywood Berner

12

34.

4 Waterproofing

8

E. Joint Stell & Bottom Apron

Joints 2 & to 50/LF

Button 10' @ to 50/LF

8

和16万.

\$163/10' = \$16.30/LF.

APPENDIX C

JOB NO.	78-312.1
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CH'D BY	PI Taley

# HAYDEN, HARDING & BUCHANAN, INC CONSULTING ENGINEERS BOSTON MASSACHUSETTS

JOB Leominate Flood SUBJECT DOWN SITE CLIENT \_\_ COFE.

Demolition				
Basis	.10	per	cubie	Foot

REACH !	•
Industrial	Complex
Industrial Bay State	Plasitics

Cost included in spaceal struct.

REACH 3	dustical SPF	36 F 6001)
+ 20 Point St.	78000	78000
+ 44 Pond St.	9000	9 000
+ 140 Bowen Place	36000	
- 121 Adams St	<b>5</b> 00	
91/9% " "	4200	4200
20 Pleasant St.	7300	7300
36	3600	
36R "	1200	
38	3600	
38 ₹ "	1200	
39	3,000	
39 12 "	4200	4200
40 "	2300	
- 40R "	500	
41	3000	
43	3600	
- 47 Laundry	10400	
- Mil	6400	6400
- n. P. Garage (Ka. Shed)	2000	2000
80	12 000	
- 84	1800	
72	200	2000
- 92 R	4 600	4600
8 CoHage St	2900	
$Q \circ $	\$ JOO	
12/13 Boyle Place	(-1	

C-1

# HAYDEN, HARDING & BUCHANAN INC. CONSULTING ENGINEERS BOSTON MASSACHUSETTS

JOB LA PARTIE TIME

SUBJECT Dangleten

CLIENT C Of E

	***************************************	
	SPF	36 FLOOD
21/25 Boyle Place	6300	
28 "	1680	1680
- 2812 "	3000	3000
33/57	6300	6300
- Zo Adams (Bank)	20000	20000
- 35 "	1500	1500
- 11 Union St (Odd Fellows)	3000	
8 Franklin St.	Z200	
Contract to	1200	
37 " "	2100	
- 7 Central St.	49000	
J - 9		
- 11/17 " "	12 800	12 800
- 21/25 " 2250	12700	12700
- 27 " " 10450		
- 33/37 " "	14200	:
49 4 11	8000	
- (a) " "	500	
65/69 "	4500	
- 15/91/95 (Forn. Store)	13000	
95 (Residence)	5000	:
104 "	3100	
106 "	2900	
18 " ^	3600	
20 " "	500	
2.2.	10 800	:
+ 85 Pleasont	(3000	13000
+ Int. Complex Adams St	304000	304000
	(710,580	\$492,680

#### INDEX

#### SPECIAL STRUCTURES

The following structures have required special consideration in the development of non-structural flood damage prevention plans:

#### Index 1

- 1. 38 Spruce Street, Tilton & Cook, Inc.
- 2. 40 Spruce Street, Bay State Plastics
- 3. 71 Water Street, Cardinal Comb Corporation
- 4. 75 Water Street, Art Plastic Company
- 5. 100 Water Street, Capital Moulding
- 6. 102 Water Street, Mock Furniture
- 7. 124 Water Street, "Industrial Complex"

### Index 3

- 1. 20 Pond Street, "Warehouse"
- 2. 44 Pond Street, Rockwell Roofing
- 3. 140 Bowen Place, "Wood Structure"
- 4. 95 Adams Street, Thom McAn

DATE 2 2H 79

Y D GAGUIN

Y D BY C.K. BOSTON

## HAYDEN, HARDING & BUCHANAN, INC. CONSULTING ENGINEERS BOSTON MASSACHUSETTS

CLIENT CO.E

le: Formione Z.

TILTON & COOK CO BB SERVE STRIET

COULDERT OF AREA CONSIDERED

PARKING

P

DEMOLITION COST

30'HT x 80'x 100'@ \$6.10 =

\$ 24,000

RESTORE REMAILING BUILDINGS

BUILD TWO LIBU COK. BLOCK WALLS LICETHA COUNTY OF BROOK DUE TO DEMOLITICAL:

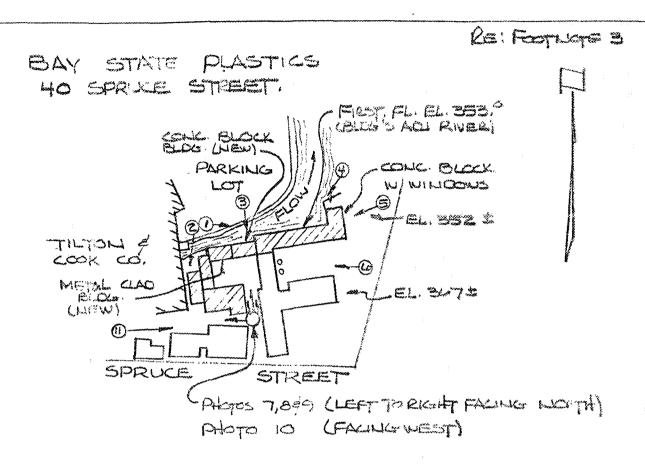
2 K 1001 × 301 @ \$3/5F = 18,000.

\$442,000

SPRIZE STREET

USE \$ 42,000

JOB LEAMINET NO BUTTON SUBJECT FLOOR PROPERLY CLIENT C. C. F.



## COST OF FLOOD PROTECTIONS

1. DEMOLITICAL

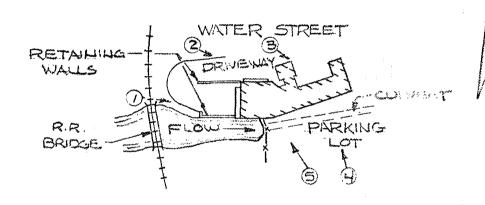
METAL CLAD: 50'x 30' x 750' @ 40.10 *	73,000
MEW BLOCK! 30'x 30' x 15' @ \$0.10 .	2,233
OFTER PORK! 190,440,450, (3) 40 10 10	15,200
MAXIS BETTE, P. S. ESONES + PONTEN L. 173 X S. J. G. P. 10 8	755
~ <i>%</i>	77.1,205
2. EARTH BEAM WY PUP RAP ARMOR	
BELM: 430'x31'x4'/27 @ +9/4Y *	27,000
ROPA 450'x 25'x3'/2" 3 720/2 -	25,000
•	*
3. BLOW DEADLAND THOMPS A PIDILIS	, 10,000

OSE. 185,030

ынает NO€ 144 JOH FORM LITTER BUBIECT FLORE PROBLEM

RE FORTHERS H

ART PLASTIC COMPANY - 75 WATER STITLET CARDINAL COME CORP . 71 WATER STEET



### COST OF FLOOD PROTECTION

1. REMOVE EXIST, RETAILING WALL 90'x1'AVE A5' @ \$ 2/CE

\$ 900.

Z. RC CAISPLENER RELAILING MAL (INCLUDES EXCHANGED BAYFILL & REIN - 8, MILE) 180' @ \$114/1F 70,575.

3 PARTIAL CHIELD . S.W. BUILDILIE I RNER JAY by 3x3x1/2 Buches (26+1#/) 1 FLITTED TO THE CONNER FOR FLOOR PROPERTY 5AY 10 66 X 20 H 1/# " Zook shall ALEHEN COLTE : ZX 4 3 7171 100 ر (آرانسية

4 WATERPROPERIE (10'x40'+240'x3')@ \$1/SF

USE \$23,000

Carrie

SHEET NO 32/14

JOB LES MILLES

CLIENT C.O. (5)

Re: Foothers 5

CAPITAL MOULDING BUILDING
(NOTE: OFFICE LOCATED AT 100 WATER ST.
SEE MOCK FURLITURE BLOG!"A" FOR
FLOOD PROOFING OF THE OFFICE).

BATEMENT LEVEL EL 351.0

BATEMENT LEVEL EL 351.0

COLE WALL

COLE BLAZIO

EL 355

EARTH BERM

| EARTH BERM | 300'x25'x5'/27 @ \$9/07 = \$12,500.

2. COLLURETE WALL | 220'x 6' @ \$12/5F = 16,560.

3. FLOOD BARRIER | 40 45 50/16 = 1,650.

4. FLOOD SHIELDS | 1,650.

3. EA. @ \$550/EA = 1,650.

5. WATTERPROXYINGS

9/x250/60 \$1/5F

#34,910.

FLOROPROGIIO COTT : 137,000

ON BC		1.518
DATE	2/23	/ <del></del>
BY	<u>)                                    </u>	المالك
4.p 8,	· RE	Capai

SHEET NO 37/44 SUBJECT FLOO PROJENICA

RE: FOOTHINGE 6

102 VATIR STREET MOCK FURNITUKE

(Note: BUILDING "A" IS THE OFFICE FOR CAPITAL MOULDING,)

FIRST FLR EL BLOG A" ELES top of Dam EL. 348.0 "ಡಿ" ಇಡಡ #107-1 TRUCK DOCK? 1100

## FLOCO PROPERIE COST

BUILDING "A"

FLOOD BARRIER: 1704 ( 1/6,30/4 = 1/2,770.

WATERPROOFING:

Exc. 220 perm x10 pp x 5 40/27@ \$28/27= 1,140

WATERPROOF: 220'NO' 6 \$1/5F 2,200, 1,465.

BACKFILL: 407 CY @ \$3 60/CY = REDURE PAVT: Indx5/9@\$8/5Y \*

755

REFAR COR SIDELYTH, BOXS' @ \$ 2/56 =

REMOVABLE SHIELDS (BASEMENT WILLDOWS)

4 x 3 x 3 5 x 4 5 50

1,2100. 410,090

500.

USE FIG. 100 - BLICE "A"

2. BUILDING "6"- NATTERPENTY LOVER Z' ALONG STEET z'x50' @ \$1/5F = \$100.

ROCKWELL
POND

ROCKWELL
POND

(SEE PHOTO #1-)
HH POND

OVER RIVER

OVER RIVER

FRUCK OXX

LOWER LEVEL

FLOOR EL. 423.0

LOWER LEVEL FLOOR EL. 423.0

LOWER LEVEL FLOOR EL. 423.0

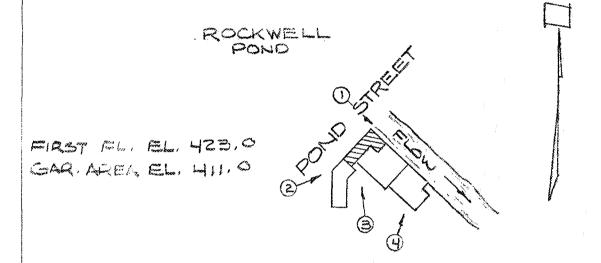
### COST OF DEMPHITION

100'x150' x 40' @ \$0 b/cf = \$60,000 100'x50' x 33' @ \$0 10/cf = 17,500 20'x 30' x 15' @ \$0.10/cf = 600 \$75,100

USE 478,000

SUBJECT FLOOP PROGRAMS
SUBJECT FLOOP PROGRAMS
CLIENT CO.E.

ROCKWELL HOME IMPROVEMIBUTE
ROCKWELL RADIFING
HH POND STREET



I. NO MEANS OF FLOCO PROSPING THIS BUILDING

RECOMMEND DEMOLITICAL

50×70×8 @ \$0,08/4= = \$2,240.

80×70×8 @ \$0,08/4= = \$1,384.

80×25×8 @ \$0,08/4= = 1,280.

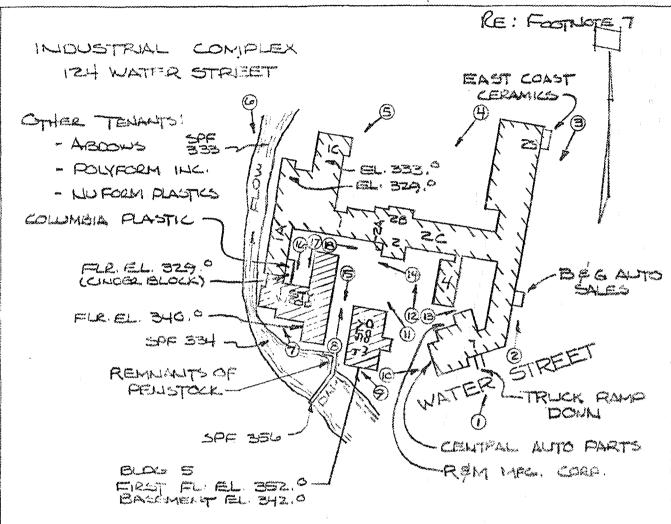
100×30×8 @ \$0.08/4= = 1,920.

\$0,024.

SAY \$ 9,000.

1 BC	١٥3	<u> </u>	312.1	
DATE		124	ودا	
			GUILL.	
מיא	BY	2 K	Pac	C*4.2
1.1			~~	

JOB LEONNING TO SUBJECT BLOOD PROPERTY C. C. C. C.



### COST OF FLOOD PROTECTION

- | DEMOLISH BLDG 5 & 1-STORY WOOD STRUCTURE |
  | BLDG 5 & 125 x 120 x 45 + 35 x 12 x 120 | 6 to 10 + 23 out of 15 x 150 x 10 x 15 6 to 10 + 23 out of 15 x 150 x 10 x 15 6 to 10 + 23 out of 15 x 150 x 10 x 15 6 to 10 x 15 for out of 15 x 150 x
- 2. EASTH BERM W. RIP KIND ANNOR.

  BERM: 320' K G' x 30'/27 (3) \$9/47 : 419, 200

  RIPRAP: 320' x 3' x 25'/27 (3) \$20/07 : 17,700
- 3 WATERPROPERLY 460' x 4.5' AVE @ 41/4" 2,070
- 4. FLOQUE PARRIERS: 300 6 \$16.30 /LF \$ 4,800 1020.

IR NO	78-317
	2/23/70
- ote-	CARCONINA
	R. K. Brainsy



BUBIECT FLOO POOPING

140 BANEW PLACE

RE: FOOTUBLE 14

BONEIL PLACE

STRUCTURE

PLACE

H STORY WOOD STRUCTURE WITH BASEMENT FIRST FL EL, 408,0

1. DEMOLITION

COST;

370' x 30' x 11'/37024 x 4 @ \$0.10/4F = \$35,640.

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OBN	o	72	٠ - :	312	<u>l</u>	
DATE		2	23	179		
AY	0	ينيك		طللك	<u> </u>	
<u>A</u> di	¥		11.		300	5

## HAYDEN, HARDING & BUCHANAN, INC. CONSULTING ENGINEERS BOSTON MASSACHUSETTS

JOB LATERAL SUBJECT FLOOP PROBLECT CO.E.

THOM MCAH WARRHOUSE (BLOCK "A")

PARAGON PLASTICS (BLOCK "B")

COMMONWEALTH PLASTIC (BLOCK "C")

COTTON & ADAMS STREETS

INDUSTRIAL COMPLEX

95 ADAMS STREET

ON STREET

ON STREET

ON STREET

ON STREET

FIRST FL.EL. 401.0

GRANITE BLOCK. RETAINING WALL

## COST OF DEMOLITION

4133,720 BLOS "A": 30'17 x 120' x 370' @ 40,10/ CF: BLOG "6": 500 x 60'x 18" 43,700. 353 220' 4 70' X25" 40,250 201 LET 4 20' Course ! 32,000 70 490 x 12 7,500 Blacker " Com" 23 440 x 25 (6) 45,203 6 x 30 x 15' 6 7.700 \$303,910

> 5004 1304,000 -- 13

